



PRODUCT GUIDE

First in Quality...First in Service • Custom, Semicustom and Standard IC's

Introduction

This Product Guide contains a complete summary of technical data and information covering Exar's full line of IC products. Each of the products presented in the Product Guide covers a wide range of applications which will greatly simplify most system designs. To help the designer find the right devices for his applications, the products listed are grouped by function and a convenient cross-reference chart is provided which shows Exar's direct replacement for a number of popular industry products.

EXPERIENCE AND PRODUCTS

Exar's innovativeness, product quality and responsiveness to customer needs have been the key to its success. Exar today offers a broad line of linear and interface circuits. In the field of standard linear IC products, Exar has extended its circuit technological leadership into the areas of communications and control circuits. Today Exar has one of the most complete lines of IC oscillators, timing circuits, and phase-locked loops in the industry. Exar also manufactures a large family of telecommunication circuits such as tone decoders, compandors, modulators, PCM repeaters, and FSK Modem Circuits. In the field of industrial control circuits, Exar manufactures a broad line of quad and dual operational amplifiers, voltage regulators, radio-control and servo driver IC's, and power circuits.

Exar's experience and expertise in the area of bipolar IC technology extends both into custom and standard IC products. In the area of custom IC's, Exar has designed, developed, and manufactured a wide range of full-custom monolithic circuits, particularly for applications in the areas of telecommunications, consumer electronics, and industrial controls.

In addition to the full-custom capability, Exar also offers a unique semi-custom IC development capability for low-to medium-volume custom circuits. This semi-custom program is intended for those customers seeking cost-effective solutions to reduce component count and board size in order to compete more effectively in a changing marketplace. The program allows a customized monolithic IC to be developed with a turnaround time of several weeks at a small fraction of the cost of a full-custom development program.

EXCELLENCE IN ENGINEERING

Exar quality starts in Engineering where highly qualified people are backed up with the advanced instruments and facilities needed for design and manufacture of custom, semi-custom, and standard integrated circuits. Exar's engineering and facilities are geared to handle all three classes of IC design: (1) semi-custom design programs using Exar's bipolar and I²L master chips; (2) full-custom IC design; (3) development and high-volume production of standard products.

Exar reserves the right to make changes at any time in order to improve design and to supply the best product possible.

Some of the challenging and complex development programs successfully completed by Exar include analog compandors and PCM repeaters for telecommunication, electronic-injection, anti-skid braking systems and voltage regulators for automotive electronics, digital voltmeter circuits, 40 MHz frequency synthesizers, high-current and high-voltage display and relay driver IC's, and many others.

NEW TECHNOLOGIES

Through company sponsored research and development activities, Exar constantly stays abreast of all technology areas related to changing customer needs and requirements. Exar has recently completed development efforts in Integrated Injection Logic (I²L) technology, which offers unique advantages in the area of low-power, high-density logic arrays. Exar has a complete design engineering group dedicated to this new technology, and is currently supplying over twenty different custom and semi-custom I²L products.

FIRST IN QUALITY

From incoming inspection of all materials to the final test of the finished goods, Exar performs sample testing of each lot to ensure that every product meets Exar's high quality standards. Exar's manufacturing process is inspected or tested in accordance with its own stringent Quality Assurance Program, which is in compliance with MIL-Q9858A. Additional special screening and testing can be negotiated to meet individual customer requirements.

Throughout the wafer fab and assembly process, the latest scientific instruments, such as scanning electron microscopes, are used for inspection, and modern automated equipment is used for wafer probe, AC, DC, and functional testing. Environmental and burn-in testing of finished products is also done in-house. For special environmental or high reliability burn-in tests outside testing laboratories are used to complement Exar's own extensive in-house facilities.

FIRST IN SERVICE

Exar has the ability and flexibility to serve the customer in a variety of ways from wafer fabrication to full parametric selection of assembled units for individual customer requirements. Special marking, special packaging and military screening are only a few of the service options available from Exar. We are certain that Exar's service is flexible enough to satisfy 99% of customer needs. The company has a large staff of Applications Engineers to assist the customer in the use of the product and to handle any request, large or small.

Exar cannot assume any responsibility for any circuits shown or represent that they are free from patent infringement.

Table of Contents

	Page
INTRODUCTION	
INDUSTRY-WIDE PRODUCT CROSS REFERENCE	1
QUALITY ASSURANCE STANDARDS	2
ORDERING INFORMATION	3

LIST OF PRODUCTS

Phase-Locked Loops

XR-210	FSK Modulator/Demodulator	4
XR-215	High-Frequency Phase-Locked Loop	4
XR-2211	FSK Demodulator/Tone Decoder	5
XR-2212	Precision Phase-Locked Loop	5

Tone Decoders

XR-567	Monolithic Tone Decoder	6
XR-2567	Dual Monolithic Tone Decoder	6

Function Generators

XR-205	Monolithic Waveform Generator	7
XR-2206	Monolithic Function Generator	7
XR-2207	Voltage-Controlled Oscillator	8
XR-2209	Precision Oscillator	8
XR-8038	Precision Waveform Generator	9

Timing Circuits

XR-320	Monolithic Timing Circuit	9
XR-555	Timing Circuit	10
XR-L555	Micropower Timing Circuit	10
XR-556	Dual Timer	11
XR-2556	Dual Timing Circuit	11
XR-2240	Programmable Timer/Counter	12
XR-2242	Long-Range Timer	12

Multipliers and Modulators

XR-2208	Operational Multiplier	13
XR-2228	Multiplier/Detector	13

Operational Amplifiers

XR-072	Dual Low-Noise BIFET Operational Amplifier	14
XR-074	Quad Low-Noise BIFET Operational Amplifier	14
XR-082	Dual BIFET Operational Amplifier	15
XR-083	Dual BIFET Operational Amplifier	15
XR-084	Quad BIFET Operational Amplifier	15
XR-094	Quad Programmable BIFET Operational Amplifier	16
XR-095	Quad Programmable BIFET Operational Amplifier	16
XR-146/246/346	Programmable Quad Operational Amplifier	17
XR-3403/3503	Quad Operational Amplifier	17
XR-4136	Quad Operational Amplifier	18
XR-4202	Programmable Quad Operational Amplifier	18
XR-4212	Quad Operational Amplifier	19
XR-4741	Quad Operational Amplifier	19
XR-1458/4558	Dual Operational Amplifier	20
XR-4739	Dual Low-Noise Operational Amplifier	20
XR-5532	Dual Low-Noise Operational Amplifier	21

Table of Contents

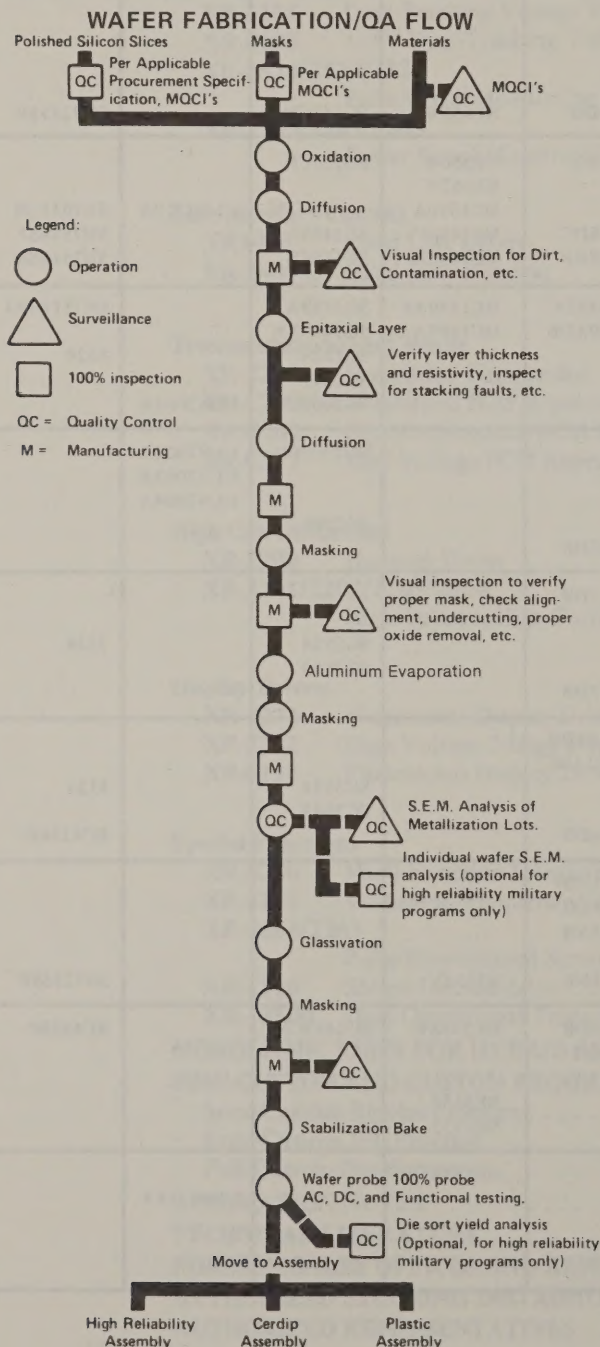
	Page
Operational Amplifiers (Continued)	
XR-5533 Dual Low-Noise Operational Amplifier	21
XR-5534 Low-Noise Operational Amplifier	22
Voltage Regulators	
XR-1468/1568 Dual-Polarity Tracking Voltage Regulator	22
XR-4194 Dual-Tracking Voltage Regulator	23
XR-4195 $\pm 15V$ Dual-Tracking Voltage Regulator	23
XR-1524/2524/3524 Pulse Width Modulating Regulator	24
XR-1543/2543/3543 Power Supply Control Circuit	24
Line Interface Circuits	
XR1488 Quad Line Driver	25
XR-1489A Quad Line Receiver	25
Telecommunication Circuits	
XR-2216 Monolithic Compandor	26
XR-C240 Monolithic PCM Repeater	26
XR-C262 High-Performance PCM Repeater	27
XR-C277 Low-Voltage PCM Repeater	27
High Current Drivers	
XR-2200 Hammer Driver	28
XR-2201/2202/2203/2204 High-Voltage, High-Current Darlington Transistor Arrays	28
Display Drivers	
XR-2271 Fluorescent Display Driver	29
XR-2272 High-Voltage 7-Digit Display Driver	29
XR-6118 Fluorescent Display Driver	30
Special Functions	
XR-S200 Multi-Function Integrated Circuit	30
XR-4151 Voltage-to-Frequency Converter	31
XR-2264/2265 Pulse-Proportional Servo Circuit	31
XR-1310 Stereo Demodulator	32
XR-13600 Dual Operational Transconductance Amplifier	32
MONOLITHIC CHIPS FOR HYBRID ASSEMBLIES	
SEMI-CUSTOM AND CUSTOM PROGRAMS	
Semi-Custom Bipolar Program	34
Semi-Custom I ² L Program	34
Full Custom Development	35
APPLICATION NOTES	
TECHNICAL LITERATURE	
FOREIGN SALES OFFICES AND REPRESENTATIVES	
AUTHORIZED STOCKING DISTRIBUTORS	
AUTHORIZED REPRESENTATIVES	

Industry-wide Product Cross Reference

XR DEVICES	Fairchild	Intersil	Motorola	National	Raytheon	Signetics	Silicon General	Sprague	Texas Instruments
072 074 082 083 084									TL072 TL074 TL082 TL083 TL084
146 246 346 346-2 555CP	555TC	NE555CPA		LM146 LM246 LM346 LM346-2 LM555CN	RC555DB	NE555V	SG555CM		SN72555P
556CP 567CP 1310P 1488N 1488P	556PC 1488DC 1488PC	NE556CPD	MC1455P MC1310P MC1488L	LM556CN LM567CN LM1310N DS1488J DC1488N	RC556DB RC1488DC RC1488DB	NE556A NE567V MC1310A MC1488F MC1488A	SG556CN SG1488J SG1488N	ULN2210A	SN76115N SN75188J SN75188N
1489AN 1489AP 1524 1543 2201CP	1489ADC 1489APC 9665PC		MC1489AL	DS1489AJ DS1489AN	RC1489ADC RC1489ADB	MC1489AF MC1489AA	SG1489AJ SG1489AN SG1524 SG1543 SG2001CN	ULN2001A	SN75189AJ 1524
2202CP 2203CP 2204CP 2206 2207CP	9666PC 9667PC		MC1411P MC1412P MC1413P		RC2207DB		SG2002CN SG2206	ULN2002A ULN2003A ULN2004A	
2211CP 2240CP 2524 2543 2567CP	2240PC				RC2211DB RC2567DB		SG2524 SG2543		2524
3403CP 3503M 3524 3543 4136CP	3403PC 3503DM 4136PC		MC3403P MC3503L		RC3403ADB RM3503ADC RC4136DB		SG3524 SG3543		3524 RC4136N
4151CP 4194CN 4195CP 4202P 4558CP	4558TC		MC1402P MC1458P	LM1458N	RC4151NB RC4194DC RC4195NB RC4558NB	N5558V			SN72558P
4739CP 4741M 4741CP 5532 5533					RC4739DB HA4741-2 HA4741-5	MC1458V NE5532 NE5533	SG1458CM		RC4558P
5534 6118 8038		ISL8038				NE5534		ULN6118A	

Quality Assurance Standards

The quality assurance program at Exar Integrated Systems defines and establishes standards and controls on manufacturing, and audits product quality at critical points during manufacturing. The accompanying Manufacturing/QA process flows illustrate where quality assurance audits, by inspection or test, the manufacturing process. The insertion of these quality assurance points is designed to insure the highest quality standards are maintained on Exar product during its manufacture.

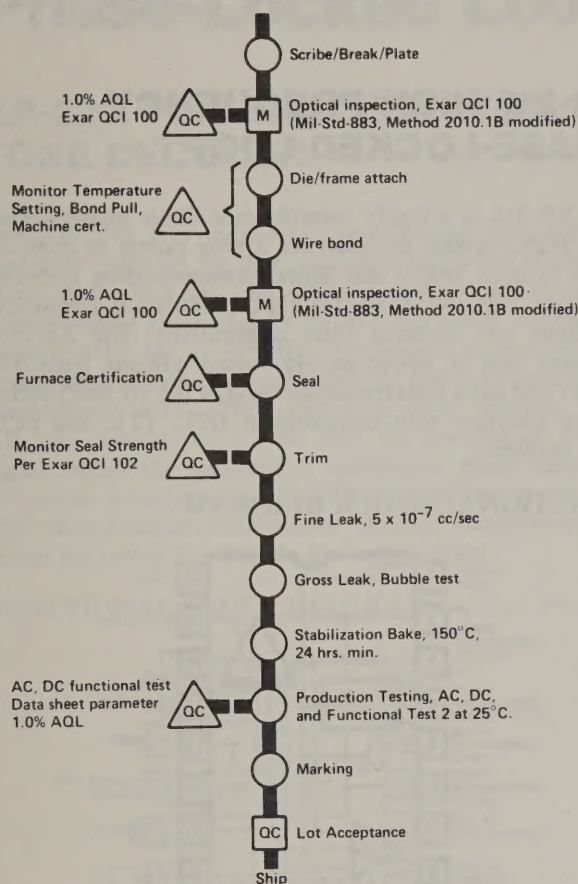


Realizing that these standard Manufacturing/QA process flows do not meet the needs of every customer's specific requirements, Exar quality assurance can negotiate and will screen product to meet any individual customer's specific requirement.

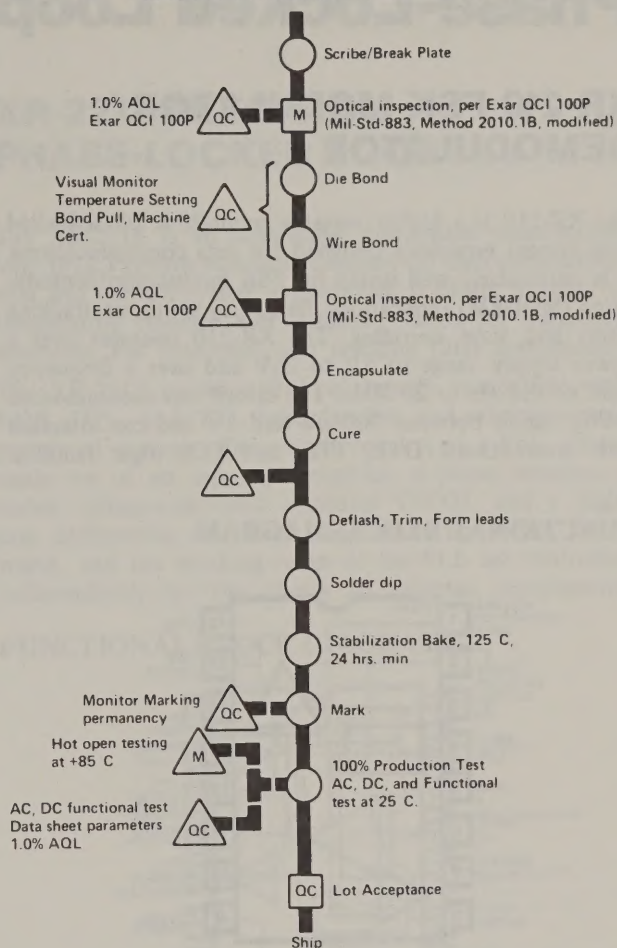
All products ending with the suffix M are fully screened to the requirements of MIL-STD-883, Method 5004, Condition C.



CERDIP ASSEMBLY/QA FLOW



PLASTIC ASSEMBLY/QA FLOW

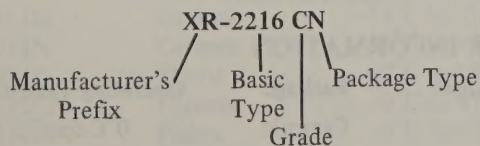


Ordering Information

PART IDENTIFICATION:

XR	—	XXXXX
Manufacturer's Prefix		Basic Type (5 spaces)
Grade		Package Type
M = Military		N = Ceramic Dual-in-line
N = Prime		P = Plastic Dual-in-line
Electrical		T = Metal can
P = Prime		D = Chip (Dice)
Electrical		A = } Kit variations
C = Commercial		B = }
K = Kit		W = Wafer

Example:



Definition of Symbols:

- M = Military Grade Part, Ceramic Package Only.
All Military Grades have been processed to MIL-STD-883 Level C, and are guaranteed to operate over military temperature range.
- N = Prime Grade Part, Ceramic Package.
- P = Prime Grade Part, Plastic Package.
- CN = Commercial Grade Part, Ceramic Package.
- CP = Commercial Grade Part, Plastic Package.

N, P, CN and CP parts are electrically identical and guaranteed to operate over 0°C to +75°C range unless otherwise stated. In addition, N and P parts generally have operating parameters more tightly controlled than the CN or CP parts.

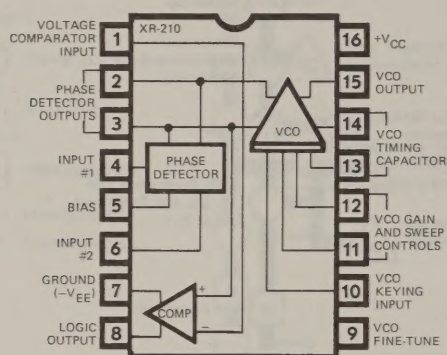
For details, consult Exar Sales Headquarters or Sales/Technical Representatives.

Phase-Locked Loops

XR-210 FSK MODULATOR/DEMODULATOR

The XR-210 is a highly versatile monolithic phase-locked loop system especially designed for data communications. It is particularly well suited for FSK modulation/demodulation (MODEM) applications, frequency synthesis, tracking filters and tone decoding. The XR-210 operates over a power supply range of 5V to 26V and over a frequency band of 0.5 Hz to 20 MHz. The circuit can accommodate analog signals between 300 μ V and 3V and can interface with conventional DTL, TTL, and ECL logic families.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Digital Programming Capability
- RS-232C Compatible Demodulator Output
- ON-OFF Keying and Sweep Capability
- Wide Tracking Range: Adjustable from $\pm 1\%$ to $\pm 50\%$
- Good Temperature Stability (200 ppm/ $^{\circ}$ C)
- High Current Logic Output (50 mA)
- Independent "Mark" and "Space" Frequency Adjustment
- VCO Duty Cycle Control

APPLICATIONS

FSK Demodulation	Tracking Filter
FSK Generation	Signal Conditioning
Data Synchronization	Tone Decoding
Frequency Synthesis	FM Detection
FM and Sweep Generation	Wideband Discrimination

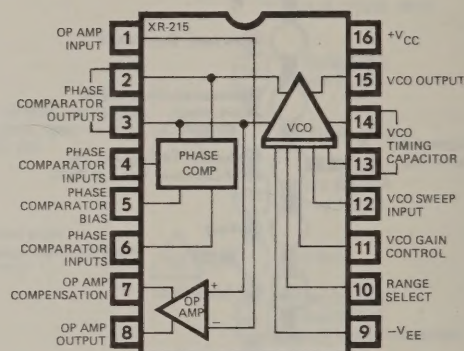
ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-210M	Ceramic	-55°C to $+125^{\circ}\text{C}$
XR-210	Ceramic	0°C to $+75^{\circ}\text{C}$

XR-215 HIGH-FREQUENCY PHASE-LOCKED LOOP

The XR-215 is a highly versatile monolithic phase-locked loop (PPL) system designed for a wide variety of applications in both analog and digital communication systems. It is especially well suited for FM demodulation, frequency synthesis and tracking filter applications. The XR-215 operates over a power supply voltage ranging from 5V to 26V and has a wide frequency band of 0.5 Hz to 35 MHz. It can interface with conventional DTL, TTL, and ECL logic families.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Wide Frequency Range: 0.5 Hz to 35 MHz
- Wide Supply Voltage Range: 5V to 26V
- Digital Programming Capability
- DTL, TTL, and ECL Logic Compatibility
- Wide Dynamic Range: 300 μ V to 3V
- ON-OFF Keying and Sweep Capability
- Wide Tracking Range: Adjustable from $\pm 1\%$ to $\pm 50\%$
- High-Quality FM Detection: Distortion 0.15%
- Signal/Noise 65 dB

APPLICATIONS

- FM Demodulation
- Frequency Synthesis
- FSK Coding/Decoding (MODEM)
- Tracking Filters
- Signal Conditioning
- FM, FSK, and Sweep Generation
- Crystal Controlled Detection
- Wideband Frequency Discrimination
- Voltage-to-Frequency Conversion

ORDER INFORMATION

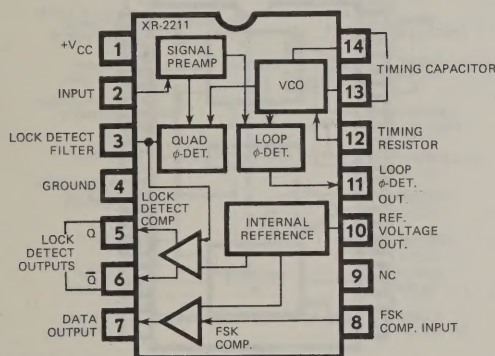
Part Number	Package	Operating Temperature
XR-215	Ceramic	0°C to $+75^{\circ}\text{C}$

Phase-Locked Loops

XR-2211 FSK DEMODULATOR/TONE DECODER

The XR-2211 is a monolithic phase-locked loop system especially designed for data communications and is particularly well-suited for FSK modem applications. It has a supply voltage range of 4.5V to 20V and a wide frequency range of 0.01 Hz to 300 kHz. The circuit accommodates analog signals between 2 mV and 3V and interfaces with conventional DTL, TTL, and ECL logic families. The XR-2211 consists of a basic PLL for tracking an input signal within the passband, a quadrature phase detector for carrier detection, and an FSK voltage comparator for FSK demodulation. Independent external components set center frequency, bandwidth, and output delay.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

Wide Frequency Range	0.01 Hz to 300 kHz
Wide Supply Voltage Range	4.5V to 20V
DDT/TTL/ECL Logic Compatibility	
FSK Demodulation, with Carrier-Detection	
Wide Dynamic Range	2 mV to 3 Vrms
Adjustable Tracking Range ($\pm 1\%$ to $\pm 80\%$)	
Excellent Temperature Stability	20 ppm/ $^{\circ}\text{C}$, Typical

APPLICATIONS

FSK Demodulation
Data Synchronization
Tone Decoding
FM Detection
Carrier Detection

ORDER INFORMATION

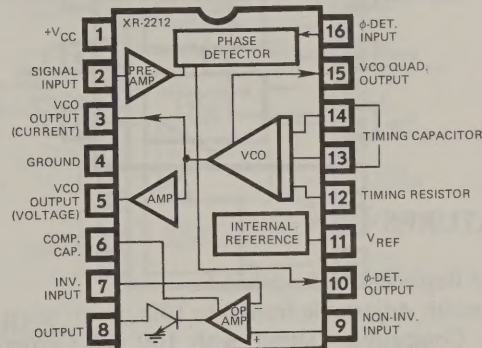
Part Number	Package	Operating Temperature
XR-2211M	Ceramic	-55°C to $+125^{\circ}\text{C}$
XR-2211N	Ceramic	-40°C to $+85^{\circ}\text{C}$
XR-2211P	Plastic	-40°C to $+85^{\circ}\text{C}$
XR-2211CN	Ceramic	0°C to $+75^{\circ}\text{C}$
XR-2211CP	Plastic	0°C to $+75^{\circ}\text{C}$

XR-2212 PRECISION PHASE-LOCKED LOOP

The XR-2212 is an ultra-stable monolithic phase-locked loop (PLL) system especially designed for data communication and control system applications. It offers 20 ppm/ $^{\circ}\text{C}$ temperature stability and is ideally suited for frequency synthesis, FM detection, and tracking filter applications.

The XR-2212 precision PLL is directly compatible with MOS, DTL, and TTL logic families and microprocessor peripheral systems. The circuit consists of a PLL system made up of an input preamplifier, a phase detector, a stable voltage-controlled oscillator (VCO), and a high-gain differential amplifier. The center frequency, bandwidth, and the tracking range of the PLL are controlled independently by the choice of external components.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

Quadrature VCO Outputs	
Wide Frequency Range	0.01 Hz to 300 kHz
Wide Supply Voltage Range	4.5V to 20V
MOS/TTL/ECL Logic Compatibility	
Wide Dynamic Range	
Adjustable Tracking Range ($\pm 1\%$ to $\pm 80\%$)	
Excellent Temperature Stability	20 ppm/ $^{\circ}\text{C}$, Typical

APPLICATIONS

Frequency Synthesis	FSK Demodulation
Data Synchronization	Signal Conditioning
FM Detection	Clock Extraction
Tracking Filters	

ORDER INFORMATION

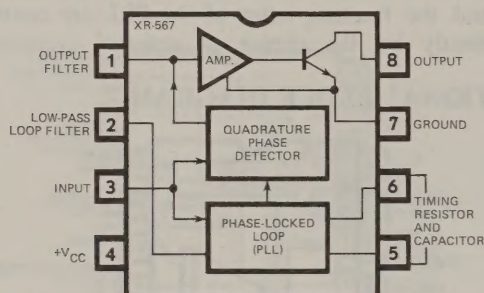
Part Number	Package	Operating Temperature
XR-2212M	Ceramic	-55°C to $+125^{\circ}\text{C}$
XR-2212N	Ceramic	-40°C to $+85^{\circ}\text{C}$
XR-2212P	Plastic	-40°C to $+85^{\circ}\text{C}$
XR-2212CN	Ceramic	0°C to $+75^{\circ}\text{C}$
XR-2212CP	Plastic	0°C to $+75^{\circ}\text{C}$

Tone Decoders

XR-567 MONOLITHIC TONE DECODER

The XR-567 is a monolithic phase-locked loop system designed for general purpose tone and frequency decoding. It offers a wide frequency band of 0.01 Hz to 500 kHz and has a logic compatible output capable of sinking up to 100 mA of load current. Four independent external components determine the bandwidth, center frequency, and output delay.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for NE567
- Bandwidth Adjustable from 0 to 14%
- Logic Compatible Output with 100 mA Current Sinking Capability
- Center Frequency Adjustable from 0.01 Hz to 500 kHz
- Inherent Immunity to False Signals
- High Rejection of Out-of-Band Signals and Noise
- Frequency Range Adjustable over 20:1 Range by External Resistor

APPLICATIONS

- Touch-Tone® Decoding
- Sequential Tone Decoding
- Communications Paging
- Ultrasonic Remote-Control and Monitoring
- Carrier-Tone Transceiver
- Wireless Intercom
- Precision Oscillator

ORDER INFORMATION

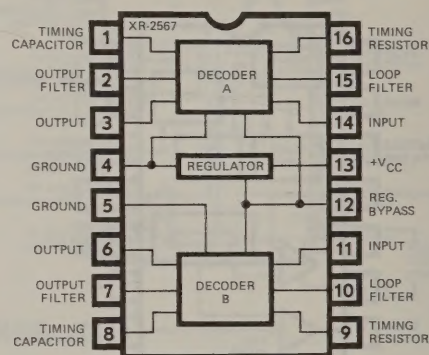
Part Number	Package	Operating Temperature
XR-567M	Ceramic	-55°C to +125°C
XR-567CN	Ceramic	0°C to +75°C
XR-567CP	Plastic	0°C to +75°C

XR-2567 DUAL MONOLITHIC TONE DECODER

The XR-2567 is a dual monolithic tone decoder well-suited for tone or frequency decoding in a multiple-tone communication system. Each decoder can be used independently or both sections can be interconnected for dual operation. The matching and temperature tracking characteristics between decoders on this one chip are superior to those available from two separate tone decoder packages.

The XR-2567 operates over a frequency range of 0.01 Hz to 500 kHz with supply voltages from 4.5V to 12V and internal voltage regulation is provided for supplies between 7V and 12V.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Replaces Two 567-Type Decoders
- Excellent Temperature Tracking Between Decoders
- Bandwidth Adjustable from 0 to 14%
- Logic Compatible Outputs with 100 mA Sink Capability
- Center Frequency Matching (1%, Typical)
- Center Frequency Adjustable from 0.01 Hz to 500 kHz
- Inherent Immunity to False Triggering

APPLICATIONS

- Touch-Tone® Decoding
- Sequential Tone Decoding
- Dual-Tone Decoding/Encoding
- Communications Paging
- Ultrasonic Remote-Control and Monitoring
- Full-Duplex Carrier-Tone Transceiver
- Wireless Intercom
- Dual Precision Oscillator
- FSK Generation and Detection

ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-2567M	Ceramic	-55°C to +125°C
XR-2567CN	Ceramic	0°C to +75°C
XR-2567CP	Plastic	0°C to +75°C

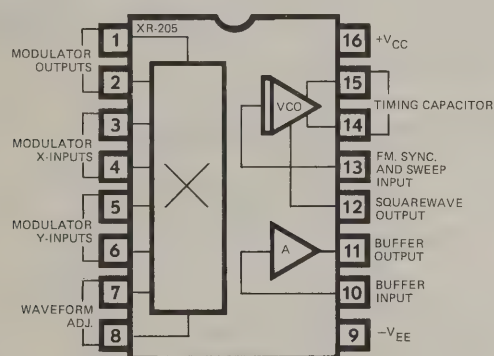
Function Generators

XR-205 MONOLITHIC WAVEFORM GENERATOR

The XR-205 is a highly versatile, monolithic waveform generator designed for diverse applications in communication and telemetry equipment, as well as in systems design and testing. It is a self-contained, totally monolithic signal generator that provides sine, square, triangle, ramp, and sawtooth output waveforms, which can be both amplitude and frequency modulated.

The circuit has three separate sections: a VCO, a balanced modulator, and a buffer amplifier.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- High Frequency Capability (to 4 MHz)
- Wide Supply Range (+8V to +26V)
- Output Current Swing of ± 10 mA
- Frequency Sweep Range of 10:1, Typical
- Low Sinewave Distortion (THD 2.5%, Typical)

APPLICATIONS

Waveform Generation

- Sinewave
- Sawtooth
- Triangle
- Ramp
- Square
- Pulse

AM Generation

FM Generation

Sweep Generation

Tone Burst Generation

Simultaneous AM/FM

FSK Signal Generation

On-Off Keyed Oscillation

Clock Generation

ORDER INFORMATION

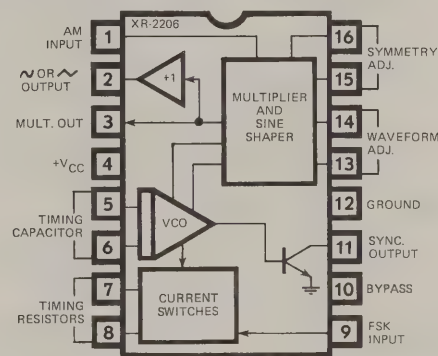
Part Number	Package	Operating Temperature
XR-205	Ceramic	0°C to +75°C

XR-2206 MONOLITHIC FUNCTION GENERATOR

The XR-2206 is a monolithic function generator integrated circuit capable of producing high quality sine, square, triangle, ramp, and pulse waveforms of high stability and accuracy. The output waveforms can be both amplitude and frequency modulated by an external voltage. Frequency of operation can be selected externally over a range of 0.01 Hz to more than 1 MHz.

This circuit is ideally suited for communications, instrumentation, and function generator applications requiring sinusoidal tone, AM, FM, or FSK generation. It has a typical drift specification of 20 ppm/°C.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Low Sinewave Distortion (THD .5%)
- Insensitive to Signal Sweep
- Excellent Stability (20 ppm/°C, Typical)
- Wide Sweep Range (2000:1, Typical)
- Low Supply Sensitivity (0.01%/V, Typical)
- Linear Amplitude Modulation
- Adjustable Duty-Cycle (1% to 99%)
- TTL Compatible FSK Controls
- Wide Supply Range (10V to 26V)

APPLICATIONS

Waveform Generation

- Sine, Square, Triangle, Ramp

Sweep Generation

AM/FM Generation

FSK and PSK Generation

Voltage-to-Frequency Conversion

Tone Generation

Phase-Locked Loops

ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-2206M	Ceramic	-55°C to +125°C
XR-2206N	Ceramic	0°C to +75°C
XR-2206P	Plastic	0°C to +75°C
XR-2206CN	Ceramic	0°C to +75°C
XR-2206CP	Plastic	0°C to +75°C

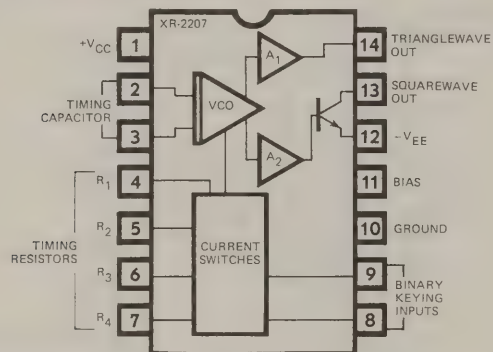
Function Generators

XR-2207 VOLTAGE-CONTROLLED OSCILLATOR

The XR-2207 is a monolithic voltage-controlled oscillator (VCO) integrated circuit featuring excellent frequency stability and a wide tuning range. The circuit provides simultaneous triangle and squarewave outputs over a frequency range of 0.01 Hz to 1 MHz. It is ideally suited for FM, FSK, sweep or tone generation, and phase-locked loop applications.

The XR-2207 has a typical drift specification of 20 ppm/°C. The oscillator frequency can be linearly swept over a 1000:1 range with an external control voltage.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Excellent Temperature Stability (20 ppm/°C)
- Linear Frequency Sweep
- Adjustable Duty Cycle (0.1% to 99.9%)
- Two or Four Level FSK Capability
- Wide Sweep Range (1000:1 Minimum)
- Logic Compatible Input and Output Levels
- Wide Supply Voltage Range ($\pm 4V$ to $\pm 13V$)
- Low Power Sensitivity (0.15%/V)
- Wide Frequency Range (0.01 Hz to 1 MHz)
- Simultaneous Triangle and Squarewave Outputs

APPLICATIONS

- FSK Generation
- Voltage and Current-to-Frequency Conversion
- Stable Phase-Locked Loop
- Waveform Generation
 - Triangle, Sawtooth, Pulse, Squarewave
- FM and Sweep Generation

ORDER INFORMATION

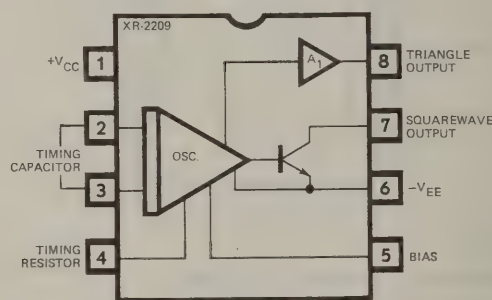
Part Number	Package	Operating Temperature
XR-2207M	Ceramic	-55°C to +125°C
XR-2207N	Ceramic	0°C to +75°C
XR-2207P	Plastic	0°C to +75°C
XR-2207CN	Ceramic	0°C to +75°C
XR-2207CP	Plastic	0°C to +75°C

XR-2209 PRECISION OSCILLATOR

The XR-2209 is a monolithic variable frequency oscillator circuit featuring excellent temperature stability and a wide linear sweep range. The circuit provides simultaneous triangle and squarewave outputs over a frequency range of 0.01 Hz to 1 MHz. The frequency is set by an external RC product. It is ideally suited for frequency modulation, voltage-to-frequency or current-to-frequency conversion, sweep or tone generation, as well as for phase-locked loop applications when used in conjunction with a phase comparator such as the XR-2208.

The circuit is comprised of three functional blocks: a variable frequency oscillator, and two buffer amplifiers. The XR-2209 has a typical drift specification of 20 ppm/°C. Its frequency can be linearly swept over a 1000:1 range with an external control signal.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Excellent Temperature Stability (20 ppm/°C)
- Linear Frequency Sweep
- Wide Sweep Range (1000:1 Minimum)
- Wide Supply Voltage Range ($\pm 4V$ to $\pm 13V$)
- Low Supply Sensitivity (0.15%/V)
- Wide Frequency Range (0.01 Hz to 1 MHz)
- Simultaneous Triangle and Squarewave Outputs

APPLICATIONS

- Voltage and Current-to-Frequency Conversion
- Stable Phase-Locked Loop Oscillator
- Waveform Generation
- FM and Sweep Generation

ORDER INFORMATION

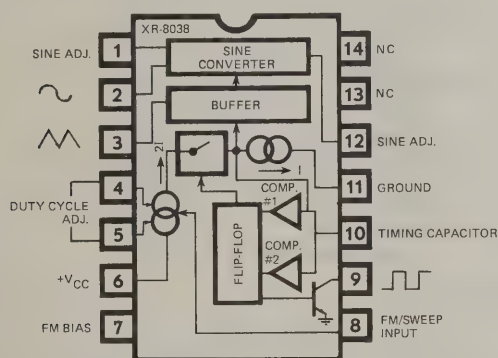
Part Number	Package	Operating Temperature
XR-2209M	Ceramic	-55°C to +125°C
XR-2209CN	Ceramic	0°C to +75°C
XR-2209CP	Plastic	0°C to +75°C

Function Generators

XR-8038 PRECISION WAVEFORM GENERATOR

The XR-8038 is a precision waveform generator IC capable of producing sine, square, triangular, sawtooth, and pulse waveforms with a minimum of external components and adjustments. Its operating frequency can be selected over nine decades of frequency, from 0.001 Hz to 1 MHz by the choice of external RC components. The frequency of oscillation is highly stable over a wide temperature and supply voltage range. The frequency modulation and sweeping can be accomplished with an external control voltage without affecting the quality of the output waveforms; and the frequency can be programmed digitally through the use of either resistors or capacitors.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for Intersil I8038
- Low Frequency Drift: 50 ppm/°C
- Simultaneous Sine-, Triangle- and Square-Wave Outputs
- Low Distortion: THD 1%
- High FM and Triangle Linearity
- Wide Frequency Range: 0.001 Hz to 1 MHz
- Minimum External Component Count
- Variable Duty-Cycle: 2% to 98%

APPLICATIONS

Precision Waveform Generation	Sweep and FM Generation
Sine, Square, Triangle, Pulse	Tone Generation
Test Instrumentation Design	Precision PLL Design
Phase-Locked Clock Generation	

ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-8038M	Ceramic	-55°C to +125°C
XR-8038N	Ceramic	0°C to +70°C
XR-8038P	Plastic	0°C to +70°C
XR-8038CN	Ceramic	0°C to +70°C
XR-8038CP	Plastic	0°C to +70°C

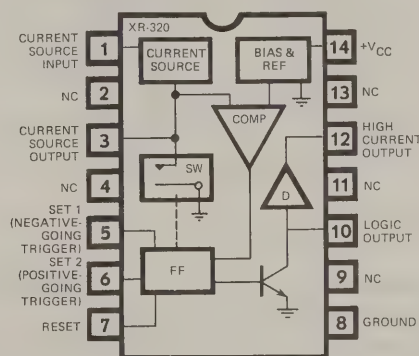
Timing Circuits

XR-320 MONOLITHIC TIMING CIRCUIT

The XR-320 monolithic timing circuit is designed for use in instrumentation and digital communications equipment, industrial control, and special testing applications. In many cases, this circuit provides a monolithic replacement for mechanical or electro-mechanical timing devices.

The XR-320 features a precision current source, a voltage comparator, a flip-flop, a timing switch, and a pair of output logic drivers. When triggered, it produces a highly-linear positive-going ramp voltage across the external timing capacitor for a duration of 2.0 RC. The high current output at pin 12 can sink or source up to 100 mA of current. The XR-320 is specified over the commercial temperature range of 0°C to +75°C.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Wide Timing Range: 1μsec to 1 Hour
- Positive- and Negative-Going Outputs
- Excellent Temperature Stability: 100 ppm/°C
- Wide Supply Voltage Range: 4.5V to 20V
- Triggering with Positive- or Negative-Going Pulses
- Programmable Timing

- 3 Decades of Resistor Programming
- 9 Decades of Capacitor Programming
- Logic Compatible Outputs
- High Current Drive Capability: 100 mA

APPLICATIONS

Precision Timing	Pulse-Position Modulation
Time-Delay Generation	Pulse-Width Modulation
Sequential Timing	Sweep Generation
Pulse Generation/Shaping	

ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-320P	Plastic	0°C to +70°C

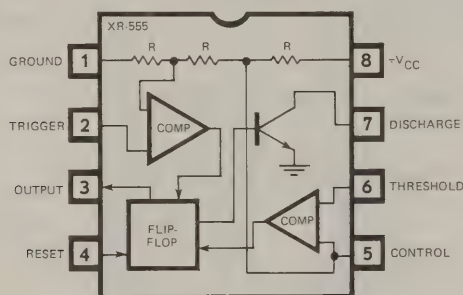
Timing Circuits

XR-555 TIMING CIRCUIT

The XR-555 monolithic timing circuit is a highly stable controller capable of producing accurate timing pulses. It is a direct, pin-for-pin replacement for the SE/NE 555 timer. The circuit contains independent control terminals for triggering or resetting, if desired.

The mode of operation can be either monostable or astable. The XR-555 may be triggered or reset on falling waveforms and its output can source or sink up to 200 mA or drive TTL circuits.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for SE/NE 555
- Timing from Microseconds through Hours
- Operates in Both Monostable and Astable Modes
- High Current Drive Capability (200 mA)
- TTL and DTL Compatible Outputs
- Adjustable Duty Cycle
- Temperature Stability of $.005\%/^{\circ}\text{C}$

APPLICATIONS

Precision Timing	Missing-Pulse Detection
Pulse Generation	Pulse-Width Modulation
Sequential Timing	Frequency Division
Pulse Shaping	Pulse-Position Modulation
Clock Generation	Appliance Timing

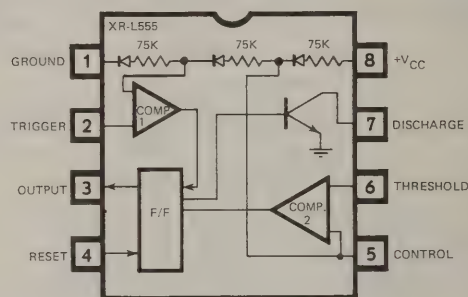
ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-555M	Ceramic	-55°C to $+125^{\circ}\text{C}$
XR-555CN	Ceramic	0°C to $+75^{\circ}\text{C}$
XR-555CP	Plastic	0°C to $+75^{\circ}\text{C}$

XR-L555 MICROPOWER TIMING CIRCUIT

The XR-L555 is a stable micropower controller capable of producing accurate timing pulses with low power dissipation. Typical power dissipation is 900 microwatts at 5V. The circuit offers both the monostable or the astable modes of operation and can operate with power supplies as low as 2.7 volts. It may be triggered or reset on falling waveforms. The output can source up to 50 mA or drive TTL circuits. The XR-L555 features temperature stability and low-voltage operation, ideal as a micropower clock oscillator or VCO for low-power CMOS systems. It can operate up to 1500 hours with only two 300 mA-Hr NiCd batteries.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Pin Compatible with Standard 555 Timer
- Less than 1 mW Power Dissipation ($V_+ = 5\text{V}$)
- Timing from Microseconds to Minutes
- Over 1000-Hour Operation with 2 NiCd Batteries
- Low Voltage Operation ($V_+ = 2.7\text{V}$)
- Operates in Both Monostable and Astable Modes
- CMOS, TTL, and DTL Compatible Outputs
- Adjustable Duty Cycle
- Temperature Stability of $.005\%/^{\circ}\text{C}$

APPLICATIONS

Battery Operated Timing	Micropower Oscillator
Micropower Clock Generator	Sequential Timing
Pulse Shaping and Detection	Pulse-Width Modulation
Micropower PLL Design	Pulse Position Modulation
Missing Pulse Detection	Appliance Timing
Power-On Reset Controller	Remote-Control Sequencer

ORDER INFORMATION

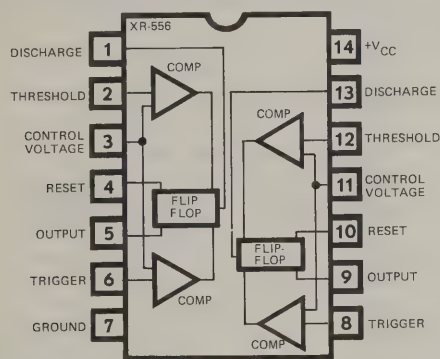
Part Number	Package	Operating Temperature
XR-L555M	Ceramic	-55°C to $+125^{\circ}\text{C}$
XR-L555CN	Ceramic	0°C to $+75^{\circ}\text{C}$
XR-L555CP	Plastic	0°C to $+75^{\circ}\text{C}$

Timing Circuits

XR-556 DUAL TIMER

The XR-556 dual timing circuit contains two independent type timers on a single monolithic chip. It is a direct pin-for-pin replacement for the SE/NE 556 dual timer. Each timer section is a highly stable controller capable of producing accurate time delays or oscillations, and each has independent outputs and control terminals. The circuit can be used for monostable or astable operation. The XR-556 may be triggered or reset on falling waveforms and each output can source up to 150 mA or drive TTL circuits. Each timer section features excellent matching and temperature tracking characteristics.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for SE/NE 556
- Replaces Two 555-Type Timers
- TTL Compatible Pinouts
- Timing from Microseconds Through Hours
- Excellent Matching Between Timer Sections
- Operates in Both Monostable and Astable Modes
- High Current Drive Capability (150 mA each output)
- TTL and DTL Compatible Outputs
- Adjustable Duty Cycle
- Temperature Stability of 0.005%/°C

APPLICATIONS

Precision Timing	Missing-Pulse Detection
Pulse Generation	Pulse-Width Modulation
Sequential Timing	Frequency Division
Pulse Shaping	Clock Synchronization
Time Delay Generation	Pulse-Position Modulation
Clock Pattern Generation	Appliance Timing

ORDER INFORMATION

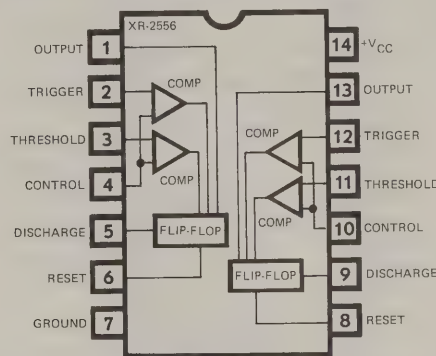
Part Number	Package	Operating Temperature
XR-556M	Ceramic	-55°C to +125°C
XR-556CN	Ceramic	0°C to +75°C
XR-556CP	Plastic	0°C to +75°C

XR-2556 DUAL TIMING CIRCUIT

The XR-2556 dual timing circuit contains two independent 555-type timers on a single monolithic chip. Each timer section is a highly stable controller capable of producing accurate timer delays or oscillations, and each has independent outputs and control terminals. Their circuit can be used for monostable or astable operation.

The XR-2556 may be triggered or reset on falling waveforms, and each output can source or sink up to 200 mA of load current, or drive DTL and TTL circuits. The matching and temperature tracking characteristics between each timer section of the XR-2556 are superior to those available from two separate timer packages.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Replaces Two 555-Type Timers
- TTL Compatible Pinouts (Gnd - Pin 7, VCC - Pin 14)
- Timing from Microseconds Through Hours
- Excellent Matching Between Timer Sections
- Operates in Both Monostable and Astable Modes
- High Current Drive Capability (200 mA each output)
- TTL and DTL Compatible Outputs
- Adjustable Duty Cycle
- Temperature Stability of 0.005%/°C

APPLICATIONS

Precision Timing	Missing-Pulse Detection
Pulse Generation	Pulse-Width Modulation
Sequential Timing	Frequency Division
Pulse Shaping	Clock Synchronization
Time Delay Generation	Pulse-Position Modulation

ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-2556M	Ceramic	-55°C to +125°C
XR-2556CN	Ceramic	0°C to +75°C
XR-2556CP	Plastic	0°C to +75°C

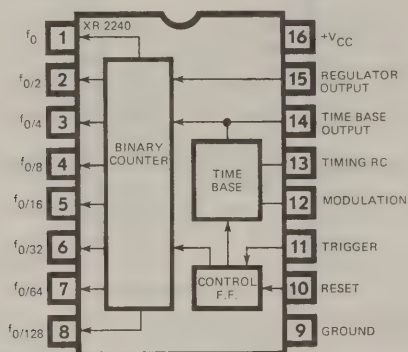
Timing Circuits

XR-2240 PROGRAMMABLE TIMER/COUNTER

The XR-2240 Programmable Timer/Counter is a monolithic controller capable of producing ultra-long time delays, from microseconds up to five days, without sacrificing accuracy. Two timing circuits can be cascaded to generate time delays up to three years. The circuit is comprised of an internal time-base oscillator, a programmable 8-bit counter, and a control flip-flop. The time delay is set by an external RC network and can be programmed to any value from 1 RC to 225 RC.

In most timing applications, one or more of the counter outputs are connected back to the reset terminal. The circuit will then start timing when a trigger is applied and will automatically reset itself to complete the timing cycle when a programmed count is completed. If none of the counter outputs are connected back to the reset terminal, the circuit will operate in its astable or free-running mode, subsequent to a trigger input.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Timing from Microseconds to Days
- Programmable Delays: 1 RC to 225 RC
- Wide Supply Range: 4V to 15V
- TTL and DTL Compatible Outputs
- High Accuracy: 0.5%
- External Sync and Modulation Capability
- Excellent Supply Rejection: 0.2%/V

APPLICATIONS

Precision Timing	Frequency Synthesis
Long Delay Generation	Pulse Counting/Summing
Sequential Timing	A/D Conversion
Binary Pattern Generation	Digital Sample and Hold

ORDER INFORMATION

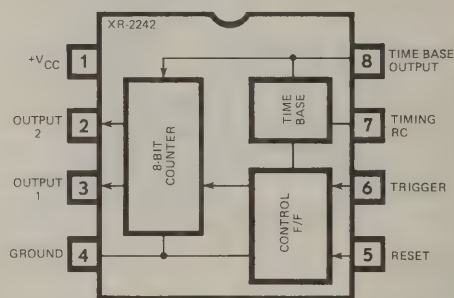
Part Number	Package	Operating Temperature
XR-2240M	Ceramic	-55°C to +125°C
XR-2240N	Ceramic	0°C to +75°C
XR-2240P	Plastic	0°C to +75°C
XR-2240CN	Ceramic	0°C to +75°C
XR-2240CP	Plastic	0°C to +75°C

XR-2242 LONG-RANGE TIMER

The XR-2242 is a monolithic Timer/Controller capable of producing ultra-long time delays from microseconds to days. Two timing circuits can be cascaded to generate time delays or timing intervals of up to one year. The circuit is comprised of an internal time-base oscillator, an 8-bit binary counter and a control flip-flop. For a given external RC network connected to the timing terminal, the circuit produces an output timing pulse of 128 RC. If two circuits are cascaded, a total time delay of $(128)^2$ or 16,384 RC is obtained.

In monostable timer applications, the output terminal (pin 3) is connected back to the reset terminal, the circuit continues to operate in an astable mode, subsequent to a trigger input.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Timing from Microseconds to Days
- Wide Supply Range: 4.5V to 15V
- TTL and DTL Compatible Outputs
- High Accuracy: 0.5%
- Excellent Supply Rejection: 0.2%/V
- Monostable and Astable Operation

APPLICATIONS

- Long Delay Generation
- Sequential Timing
- Precision Timing
- Ultra-Low Frequency Oscillator
- Interval Timing

ORDER INFORMATION

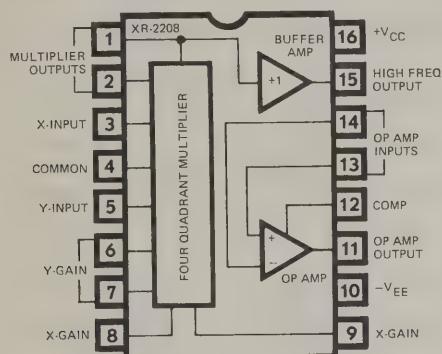
Part Number	Package	Operating Temperature
XR-2242M	Ceramic	-55°C to +125°C
XR-2242CN	Ceramic	0°C to +75°C
XR-2242CP	Plastic	0°C to +75°C

Multipliers and Modulators

XR-2208 OPERATIONAL MULTIPLIER

The XR-2208 operational multiplier combines a four-quadrant analog multiplier (or modulator), a high-frequency buffer amplifier and an operational amplifier in a monolithic circuit that is ideally suited for both analog computation and communications signal processing application. The multiplier/buffer amplifier combination extends the small signal 3 dB bandwidth to 8 MHz and the transconductance bandwidth to 100 MHz.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Maximum Versatility
 - Independent Multiplier, Op Amp and Buffer
- Excellent Linearity (0.3%, typical)
- Wide Bandwidth
 - 3 dB Bandwidth – 8 MHz typical
 - 3° Phase Shift Bandwidth – 1.2 MHz typical
 - Transconductance Bandwidth – 100 MHz typical
- Simplified Offset Adjustments
- Wide Supply Voltage Range ($\pm 4.5V$ to $\pm 16V$)

APPLICATIONS

- | | |
|--------------------------|--------------------------------|
| Analog Computation | Triangle-to-Sinewave Converter |
| Multiplication | AGC Amplifier |
| Division | Phase Detector |
| Signal Processing | Motor Speed Control |
| AM Generation | Phase-Locked AM Demodulation |
| Frequency Doubling | |
| Frequency Translation | |
| Synchronous AM Detection | |

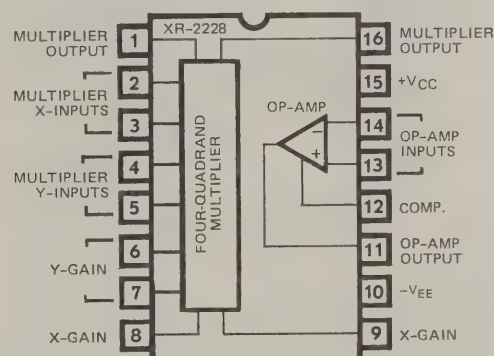
ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-2208M	Ceramic	$-55^{\circ}C$ to $+125^{\circ}C$
XR-2208N	Ceramic	$0^{\circ}C$ to $+75^{\circ}C$
XR-2208P	Plastic	$0^{\circ}C$ to $+75^{\circ}C$
XR-2208CN	Ceramic	$0^{\circ}C$ to $+75^{\circ}C$
XR-2208CP	Plastic	$0^{\circ}C$ to $+75^{\circ}C$

XR-2228 MULTIPLIER/DETECTOR

The XR-2228 multiplier/detector circuit is designed as a basic building block for analog signal processing and communication systems. It contains a four-quadrant analog multiplier/modulator and a high-gain op-amp on the same chip. Because of its wide common-mode range and differential inputs, the XR-2228 can interface with any of the existing PLL circuits in designing synchronous AM detection or frequency translation systems. It can be used as a phase-detector for frequencies up to 100 MHz.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Maximum Versatility
 - Independent Multiplier and Op Amp
- Differential X and Y Inputs
- Interfaces with all PLL and VCO Circuits
- Wide Common Mode Range
- Wide Transconductance Bandwidth (100 MHz, Typ.)

APPLICATIONS

- Phase-Locked Loop Design
- Phase Detection
- Synchronous AM Detection
- AM Generation
- Triangle-to-Sinewave Conversion
- Frequency Translation

ORDER INFORMATION

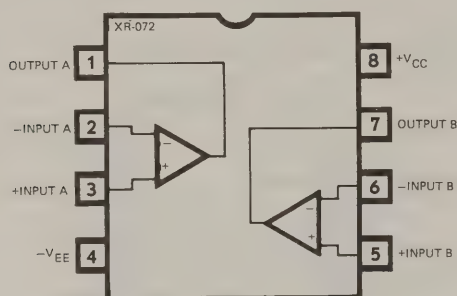
Part Number	Package	Operating Temperature
XR-2228M	Ceramic	$-55^{\circ}C$ to $+125^{\circ}C$
XR-2228CN	Ceramic	$-40^{\circ}C$ to $+85^{\circ}C$
XR-2228CP	Plastic	$0^{\circ}C$ to $+75^{\circ}C$

Operational Amplifiers

XR-072 DUAL LOW-NOISE BIFET OPERATIONAL AMPLIFIER

The XR-072 family of junction-FET input dual op-amps are the low-noise version of Exar's XR-082 dual BIFET op-amp circuits. The combination of low noise, high slew-rate and the low output distortion characteristics of these op-amps make them ideal for high gain audio preamplification or analog signal processing systems.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for Texas Instruments TL072
- Low Noise ($V_n = 18 \text{ nV}/\sqrt{\text{Hz}}$ Typ.)
- Low Harmonic Distortion (0.01% Typ.)
- Same Pin Configuration as XR-1458/XR-4558
- Low Power Consumption
- Low Input Bias and Offset Currents
- Output Short-Circuit Protection
- High Input Impedance . . . FET-Input Stage
- Internal Frequency Compensation
- Latch-Up-Free Operation
- High Slew-Rate . . . 13 V/ μs , Typ.

APPLICATIONS

- High-Quality Audio Preamplification
- Low-Level Signal Detection
- Active Filter Design
- Signal Conditioning
- Analog Amplification
- Audio Signal Processing

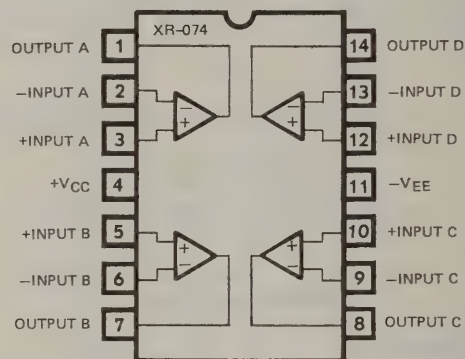
ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-072M	Ceramic	-55°C to +125°C
XR-072N	Ceramic	-25°C to +85°C
XR-072P	Plastic	-25°C to +85°C
XR-072CN	Ceramic	0°C to +75°C
XR-072CP	Plastic	0°C to +75°C

XR-074 QUAD LOW-NOISE BIFET OPERATIONAL AMPLIFIER

The XR-074 junction FET-input quad operational amplifier is the low-noise version of Exar's XR-084 quad BIFET op-amp circuit. The low noise and low harmonic distortion characteristics make the XR-074 family of quad op-amps ideally suited for high-fidelity and audio preamplifier applications. Each of the four low-noise op-amps on the chip is fabricated using ion-implantation technology which combines well-matched junction FETs and high-performance bipolar transistors on the same monolithic integrated circuit.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for Texas Instruments TL074
- Low Noise ($V_n = 18 \text{ nV}/\sqrt{\text{Hz}}$ Typ.)
- Same Pin Configuration as XR-3403
- High-Impedance Junction FET-Input Stage
- Internal Frequency Compensation
- Low Power Consumption
- Low Harmonic Distortion (0.01% Typ.)
- Output Short-Circuit Protection
- High Slew-Rate . . . 13 V/ μs , Typ.

APPLICATIONS

- High-Quality Audio Preamplification
- Low-Level Signal Detection
- Active Filter Design
- Signal Conditioning
- Analog Amplification
- Audio Signal Processing

ORDER INFORMATION

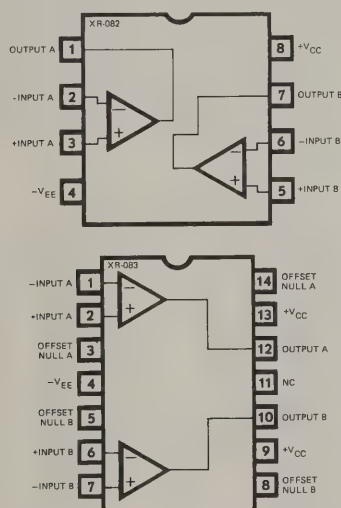
Part Number	Package	Operating Temperature
XR-074M	Ceramic	-55°C to +125°C
XR-074N	Ceramic	-25°C to +85°C
XR-074P	Plastic	-25°C to +85°C
XR-074CN	Ceramic	0°C to +75°C
XR-074CP	Plastic	0°C to +75°C

Operational Amplifiers

XR-082/XR-083 DUAL BIFET OPERATIONAL AMPLIFIERS

The XR-082/XR-083 family of junction-FET input (BIFET) dual operational amplifiers are designed to offer high performance and a wider selection than conventional bipolar op-amps. Each amplifier features high slew rate, low input bias and offset currents, and low offset voltage drift with temperature.

FUNCTIONAL BLOCK DIAGRAMS



Note: Pins 9 and 13 are internally connected.

FEATURES

- Direct Replacement for Texas Instrument TL082 and TL083
- Low Power Consumption
- Wide Common-Mode and Differential Voltage Ranges
- Low Input Bias and Offset Currents
- Output Short-Circuit Protection
- High Input Impedance: FET Input Stage
- Internal Frequency Compensation
- Latch-Up Free Operation
- High Slew Rate: 13V/ μ s, Typical

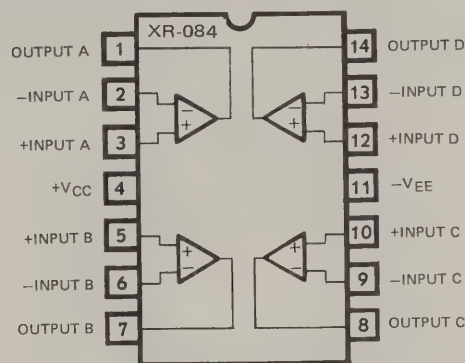
ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-082M	Ceramic	-55°C to +125°C
XR-082N	Ceramic	-25°C to +85°C
XR-082P	Plastic	-25°C to +85°C
XR-082CN	Ceramic	0°C to +75°C
XR-082CP	Plastic	0°C to +75°C
XR-083M	Ceramic	-55°C to +125°C
XR-083N	Ceramic	-25°C to +85°C
XR-083P	Plastic	-25°C to +85°C
XR-083CN	Ceramic	0°C to +75°C
XR-083CP	Plastic	0°C to +75°C

XR-084 QUAD BIFET OPERATIONAL AMPLIFIER

The XR-084 junction-FET input (BIFET) quad operational amplifier is designed to offer higher performance than conventional bipolar quad op-amps. Each of the four op-amps on the chip is closely matched in performance characteristics, and each amplifier features high slew rate, low input bias and offset currents, and low offset voltage drift with temperature. The XR-084 FET input quad op-amp is fabricated using ion-implantation technology which combines well-matched junction FETs and high-performance bipolar transistors on the same monolithic integrated circuit.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for Texas Instrument TL084
- Same Pin Configuration as XR-3403, LM324
- High-Impedance Junction-FET Input Stage
- Internal Frequency Compensation
- Low Power Consumption
- Wide Common-Mode and Differential Voltage Ranges
- Low Input Bias and Offset Currents
- Output Short-Circuit Protection
- Latch-Up Free Operation
- High Slew Rate: 13V/ μ s, Typical

APPLICATIONS

- Active Filter Design
- Sample/Hold and Servo Systems
- Audio Signal Processing
- Analog Control Systems

ORDER INFORMATION

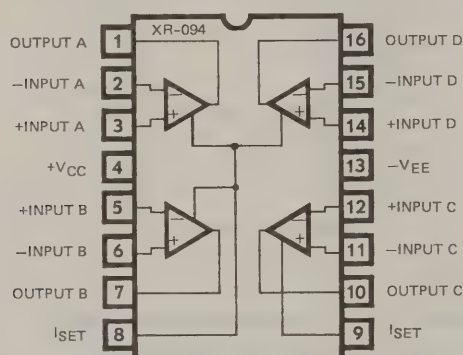
Part Number	Package	Operating Temperature
XR-084M	Ceramic	-55°C to +125°C
XR-084N	Ceramic	-25°C to +85°C
XR-084P	Plastic	-25°C to +85°C
XR-084CN	Ceramic	0°C to +75°C
XR-084CP	Plastic	0°C to +75°C

Operational Amplifiers

XR-094 QUAD PROGRAMMABLE BIFET OPERATIONAL AMPLIFIER

The XR-094 is a programmable version of the XR-084 family of quad FET-input operational amplifiers. The circuit offers partitioned programming where the three of the four op-amps on the chip are programmed by one external bias-setting resistor, and the fourth op-amp is programmed by a second bias-setting resistor. These two external setting resistors permit the user to program the gain-bandwidth product, slew-rate and the supply current, especially for low power applications. The XR-094 programmable BIFET quad op-amp is fabricated using ion-implantation technology which combines well-matched junction FETs and high-performance bipolar transistors on the same monolithic integrated circuit.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Programmable Version of Texas Instruments TL084
- Same Pin Configuration as LM146/246/346
- Programmable for Micropower Operation
- Partitioned Programming (Single/Triple Combination)
- High-Impedance Junction-FET Input Stage
- Internal Frequency Compensation
- Low Input Bias and Offset Currents

APPLICATIONS

Active Filter Design	Audio Signal Processing
Sample/Hold and	Analog Control Systems
Servo Systems	Telephone Channel Filters

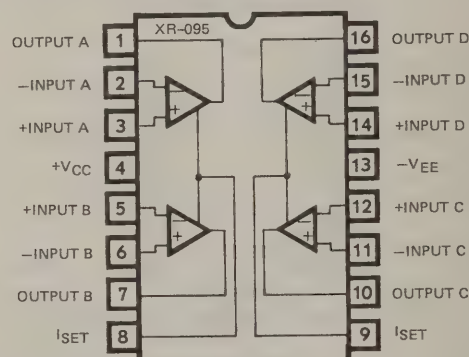
ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-094M	Ceramic	-55°C to +125°C
XR-094N	Ceramic	-25°C to +85°C
XR-094P	Plastic	-25°C to +85°C
XR-094CN	Ceramic	0°C to +75°C
XR-094CP	Plastic	0°C to +75°C

XR-095 QUAD PROGRAMMABLE BIFET OPERATIONAL AMPLIFIER

The XR-095 is a programmable version of the XR-084 family of quad FET-input operational amplifiers. The circuit offers partitioned programming of the individual op-amp sections on the chip: two of the op-amps are programmed by one bias-setting resistor, and the remaining two op-amps are programmed by a separate bias-setting resistor. These two external setting resistors permit the user to program the gain-bandwidth product, slew-rate and the supply current, especially for low power applications. The XR-095 programmable BIFET quad op-amp is fabricated using ion-implantation technology which combines well-matched junction FETs and high-performance bipolar transistors on the same monolithic integrated circuit.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Programmable Version of Texas Instruments TL084
- Same Pin Configuration as LM346-2
- Partitioned Programming (Two Dual Combination)
- Programmable for Micropower Operation
- High-Impedance Junction-FET Input Stage
- Internal Frequency Compensation
- Low Input Bias and Offset Currents

APPLICATIONS

Active Filter Design	Audio Signal Processing
Sample/Hold and	Analog Control Systems
Servo Systems	Telecommunication Systems

ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-095M	Ceramic	-55°C to +125°C
XR-095N	Ceramic	-25°C to +85°C
XR-095P	Plastic	-25°C to +85°C
XR-095CN	Ceramic	0°C to +75°C
XR-095CP	Plastic	0°C to +75°C

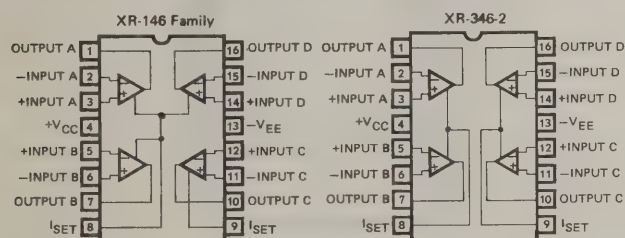
Operational Amplifiers

XR-146/246/346 PROGRAMMABLE QUAD OPERATIONAL AMPLIFIER

The XR-146 family of quad operational amplifiers contain four independent high-gain, low-power, programmable op-amps on a monolithic chip. The use of external bias setting resistors permit the user to program gain-bandwidth product, supply current, input bias current, input offset current, input noise and the slew rate.

The basic XR-146 family of circuits offer partitioned programming of the internal op-amps where one setting resistor is used to set the bias levels in the three op-amps, and a second bias setting is used for the remaining op-amp. Its modified version, the XR-346-2 provides a separate bias setting resistor for each of the two op-amp pairs.

FUNCTIONAL BLOCK DIAGRAMS



FEATURES

- Direct Replacement for LM146/246/346 (XR-146 Family)
- Direct Replacement for LM346-2 (XR-346-2)
- Programmable Electrical Characteristics
- Low Supply Current (350 μ A per Amplifier)
- Large DC Voltage Gain (120 dB)
- Low Noise Voltage (25 nV/ $\sqrt{\text{Hz}}$)
- Wide Power Supply Range ($\pm 1.5\text{V}$ to $\pm 22\text{V}$)
- Class AB Output Stage—No Crossover Distortion

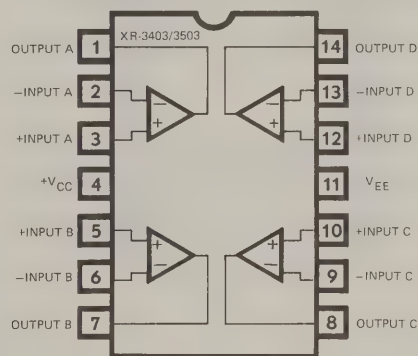
ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-146M	Ceramic	-55°C to $+125^{\circ}\text{C}$
XR-246N	Ceramic	-25°C to $+85^{\circ}\text{C}$
XR-246P	Plastic	-25°C to $+75^{\circ}\text{C}$
XR-346CN	Ceramic	0°C to $+75^{\circ}\text{C}$
XR-346CP	Plastic	0°C to $+75^{\circ}\text{C}$
XR-346-2CN	Ceramic	0°C to $+75^{\circ}\text{C}$
XR-346-2CP	Plastic	0°C to $+75^{\circ}\text{C}$

XR-3403/3503 QUAD OPERATIONAL AMPLIFIER

The XR-3403 is an array of four independent operational amplifiers, each with true differential inputs. The device has electrical characteristics similar to the popular 741. However, the XR-3403 has several distinct advantages over standard operational amplifier types in single supply applications. The XR-3403 can operate at supply voltages as low as 3.0 volts or as high as 36 volts with quiescent currents about one-fifth of those associated with the 741 (on a per amplifier basis). The common mode input range includes the negative supply, thereby eliminating the necessity for external biasing components in many applications. The output voltage swing extends to the negative supply.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Pin-for-Pin Replacement for MC3403/3503, LM324, and RC4137
- Suitable for Single-Supply Operation
- Short Circuit Protected Outputs
- Class AB Output Stage (No Crossover Distortion)
- Single Supply Operation: 3.0 to 36 Volts
- Split Supply Operation: ± 1.5 to ± 18 Volts
- Low Input Bias Currents: 500 nA Maximum
- Four Amplifiers per Package
- Internally Compensated

ORDER INFORMATION

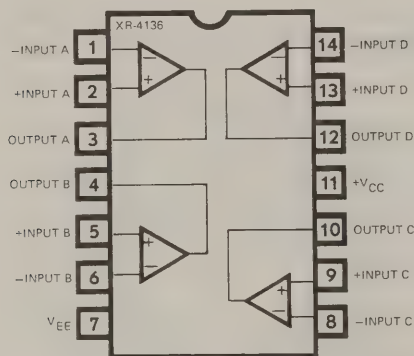
Part Number	Package	Operating Temperature
XR-3503M	Ceramic	-55°C to $+125^{\circ}\text{C}$
XR-3403CN	Ceramic	0°C to $+75^{\circ}\text{C}$
XR-3403CP	Plastic	0°C to $+75^{\circ}\text{C}$

Operational Amplifiers

XR-4136 QUAD OPERATIONAL AMPLIFIER

The XR-4136 is an array of four independent internally-compensated operational amplifiers on a single silicon chip, each similar to the popular 741, but with a power consumption less than one 741. Good thermal tracking and matched gain-bandwidth products make these quad op-amps useful for active filter applications.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Pin-for-Pin Replacement for RC4136 and RM4136
- Low Power Consumption (50 mW typ and 120 mW max)
- Short-Circuit Protection
- Internal Frequency Compensation
- No Latch-Up
- Wide Common-Mode and Differential Voltage Ranges
- Matched Gain-Bandwidth

APPLICATIONS

- Active Filter Design
- Signal Conditioning
- Analog Amplification
- Audio Signal Processing

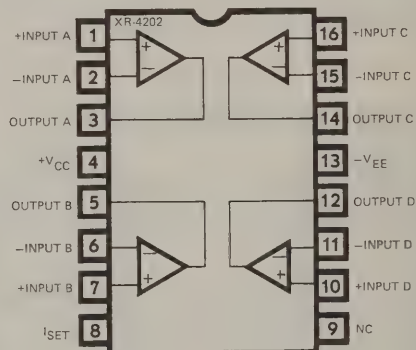
ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-4136M	Ceramic	-55°C to +125°C
XR-4136CN	Ceramic	0°C to +75°C
XR-4136CP	Plastic	0°C to +75°C

XR-4202 PROGRAMMABLE QUAD OPERATIONAL AMPLIFIER

The XR-4202 is an array of four independent operational amplifiers on a single silicon chip. The operating current of the array is externally controlled by a single setting resistor or current source, allowing the user to trade-off power dissipation for bandwidth for all of the four amplifiers in the package.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Programmable
- Micropower Operation
- Wide Input Voltage and Common Mode Range
- Internal Frequency Compensation
- No Latch-Up
- Matched Parameters
- Short Circuit Protection

APPLICATIONS

- Active Filter Design
- Signal Conditioning
- Analog Amplification
- Audio Signal Processing

ORDER INFORMATION

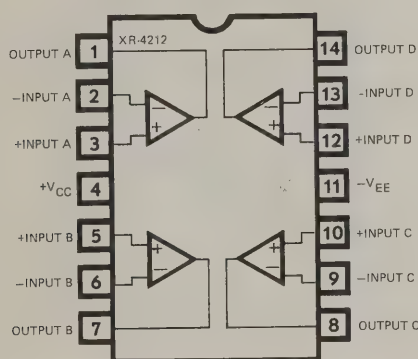
Part Number	Package	Operating Temperature
XR-4202N	Ceramic	-40°C to +85°C
XR-4202P	Plastic	-40°C to +85°C

Operational Amplifiers

XR-4212 QUAD OPERATIONAL AMPLIFIER

The XR-4212 is an array of four independent, internally-compensated operational amplifiers on a single silicon chip, each similar in performance to the popular 741. However, the combined power consumption of all four op-amps is less than that of a single, conventional 741-type op-amp. Good thermal tracking and matched gain-bandwidth products make these quad op-amps useful for active filter applications.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Same Pinout as MC3403, LM324, and HA4741
- Low Power Consumption (50 mW typ and 120 mW max)
- Short-Circuit Protection
- Internal Frequency Compensation
- No Latch-Up
- Wide Common-Mode and Differential Voltage Ranges
- Matched Gain-Bandwidth

APPLICATIONS

- Active Filter Design
- Signal Conditioning
- Analog Amplification
- Audio Signal Processing

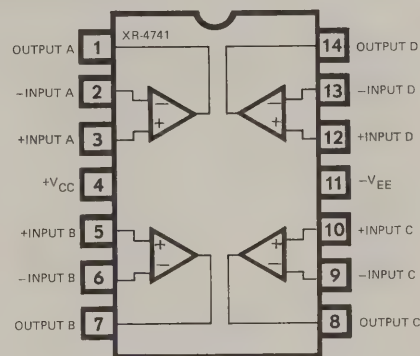
ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-4212M	Ceramic	-55°C to +125°C
XR-4212CN	Ceramic	0°C to +75°C
XR-4212CP	Plastic	0°C to +75°C

XR-4741 QUAD OPERATIONAL AMPLIFIER

The XR-4741 is an array of four independent internally-compensated operational amplifiers on a single silicon chip, each similar to the popular 741. Each amplifier offers performance equal to or better than the 741 type in all respects. It has high slew rate, superior bandwidth, and low noise, which makes it excellent for audio amplifiers or active filter applications

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Pin-for-Pin Replacement for HA4741
- Pin Compatible with MC3403 and LM324
- High Slew Rate: 1.6V/ μ S (Typ)
- Unity Gain-Bandwidth: 3.5 MHz (Typ)
- Low Noise Voltage: 9 nV/ $\sqrt{\text{Hz}}$ (Typ)
- Input Offset Current: .5 mV (Typ)
- Wide Supply Range: $\pm 2\text{V}$ to $\pm 20\text{V}$

APPLICATIONS

- Active Filter Design
- Signal Conditioning
- Analog Amplification
- Audio Signal Processing

ORDER INFORMATION

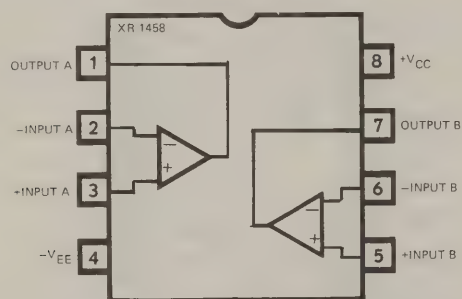
Part Number	Package	Operating Temperature
XR-4741M	Ceramic	-55°C to +125°C
XR-4741CN	Ceramic	0°C to +75°C
XR-4741CP	Plastic	0°C to +75°C

Operational Amplifiers

XR-1458/4558 DUAL OPERATIONAL AMPLIFIER

The XR-1458/4558 is a pair of independent internally-compensated operational amplifiers on a single silicon chip, each similar in performance to the popular 741. However, the power consumption of each of the op-amps is less than one-half of the power consumption of a conventional 741. Good thermal tracking and matched gain-bandwidth products make these dual op-amps useful for active filter applications.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Pin-for-Pin Replacement for MC1458, RC4558, NE5558
- Low Power Consumption (50 mW typ and 120 mW max)
- Short-Circuit Protection
- Internal Frequency Compensation
- No Latch-Up
- Wide Common-Mode and Differential Voltage Ranges
- Matched Gain-Bandwidth

APPLICATIONS

- Active Filter Design
- Signal Conditioning
- Analog Amplification
- Audio Signal Processing

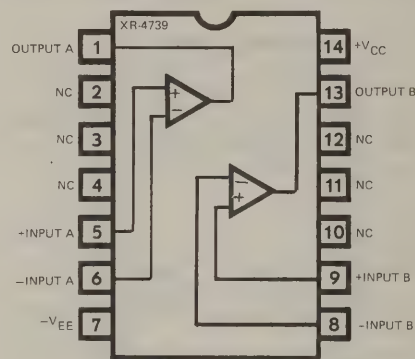
ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-1458CP	Plastic	0°C to +70°C
XR-4558CP	Plastic	0°C to +70°C

XR-4739 DUAL LOW-NOISE OPERATIONAL AMPLIFIER

The XR-4739 dual low-noise operational amplifier is fabricated on a single silicon chip using Exar's low-noise planar epitaxial process. It is designed primarily for pre-amplifiers in a consumer and industrial signal processing equipment. The device is pin-compatible with the μ A739 and MC1303, with internal compensation added. This permits a reduced external parts count and simplified application.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Pin-for-Pin Replacement for RC4739
- Internally Compensated Replacement for μ A739 and MC1303
- Signal-to-Noise Ratio 76 dB (R1AA 10 mV ref.)
- Channel Separation 125 dB
- Unity Gain-Bandwidth 3 MHz
- Output Short-Circuit Protected
- 0.1% Distortion at 8.5V RMS Output into 2K Ω Load

APPLICATIONS

- High-Quality Audio Preamplification
- Low-Level Signal Detection
- Active Filter Design
- Signal Conditioning
- Analog Amplification
- Audio Signal Processing

ORDER INFORMATION

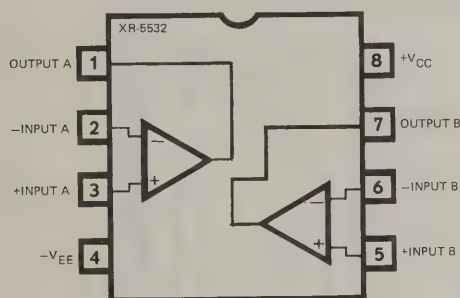
Part Number	Package	Operating Temperature
XR-4739CN	Ceramic	0°C to +75°C
XR-4739CP	Plastic	0°C to +75°C

Operational Amplifiers

XR-5532 DUAL LOW-NOISE OPERATIONAL AMPLIFIER

The XR-5532 ultra-low noise dual operational amplifier is especially designed for high quality audio and instrumentation applications. Compared to the standard 741- or 301A-type op-amps, these operational amplifiers show an order of magnitude better noise performance and small-signal bandwidth, and higher output drive capability. The XR-5532 is internally compensated and is available in 8-pin package.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for NE5532
- Ultra-Low Input Noise ($4 \text{ nV}/\sqrt{\text{Hz}}$ Typ.)
- Wide Small-Signal Bandwidth (10 MHz Typ.)
- High Output Drive Capability (10 V rms into 600Ω)
- Wide Supply Range ($\pm 3\text{V}$ to $\pm 20\text{V}$)
- Wide Power Bandwidth (200 kHz)
- High Slew-Rate: $6\text{V}/\mu\text{sec}$

APPLICATIONS

Professional Audio Equipment	Telephone Channel Amplifier
Instrumentation and Servo Control	Low-Level Signal Processing
	Audio Preamplification

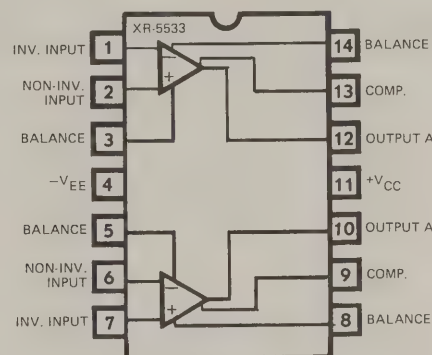
ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-5532M	Ceramic	-55°C to $+125^{\circ}\text{C}$
XR-5532CN	Ceramic	0°C to $+75^{\circ}\text{C}$
XR-5532CP	Plastic	0°C to $+75^{\circ}\text{C}$

XR-5533 DUAL LOW-NOISE OPERATIONAL AMPLIFIER

The XR-5533 ultra-low noise dual operational amplifier is especially designed for high quality audio and instrumentation applications. Compared to the standard 741- or 301A-type op-amps, these operational amplifiers show an order of magnitude better noise performance and small-signal bandwidth, and higher output drive capability. The XR-5533 is internally compensated for a voltage gain of three or more and offers independent offset adjustments for each of the two op-amps.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for NE5533
- Dual Version of XR-5534 or NE5534
- Ultra-Low Input Noise ($4 \text{ nV}/\sqrt{\text{Hz}}$ Typ.)
- Wide Small-Signal Bandwidth (10 MHz Typ.)
- High Output Drive Capability (10 V rms into 600Ω)
- Wide Supply Range ($\pm 3\text{V}$ to $\pm 20\text{V}$)
- Wide Power Bandwidth (200 kHz)
- High Slew-Rate: $13 \text{ V}/\mu\text{sec}$
- Independent Offset Adjustments

APPLICATIONS

Professional Audio Equipment	Telephone Channel Amplifier
Instrumentation and Servo Control	Low-Level Signal Processing
	Audio Preamplification

ORDER INFORMATION

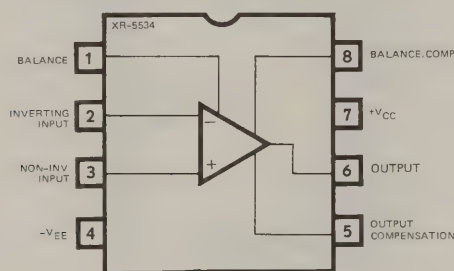
Part Number	Package	Operating Temperature
XR-5533M	Ceramic	-55°C to $+125^{\circ}\text{C}$
XR-5533CN	Ceramic	0°C to $+75^{\circ}\text{C}$
XR-5533CP	Plastic	0°C to $+75^{\circ}\text{C}$

Operational Amplifiers

XR-5534 LOW-NOISE OPERATIONAL AMPLIFIER

The XR-5534 is a high performance, ultra-low noise operational amplifier. Compared to standard 741- or 301-type op-amps, it shows an order of magnitude better noise performance and small-signal bandwidth and significantly better output drive capability. The XR-5534 is ideally suited for application in high quality and professional audio equipment, in instrumentation and control circuits and telephone channel amplifiers. The op-amp is internally compensated for gain equal to, or higher than, three. The frequency response can be optimized with an external compensation capacitor for various applications requiring unity-gain, capacitive load driving or low-overshoot response.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for NE5534
- Ultra-Low Input Noise ($4 \text{ nV}/\sqrt{\text{Hz}}$ Typ.)
- Wide Small-Signal Bandwidth (10 MHz Typ.)
- High Output Drive Capability (10V rms into 600Ω)
- Wide Supply Range ($\pm 3\text{V}$ to $\pm 20\text{V}$)
- Wide Power Bandwidth (200 kHz)
- High Voltage Gain:
 - $A_v = 100,000$ at DC
 - $A_v = 6,000$ at 10 kHz
- High Slew-Rate: $13 \text{ V}/\mu\text{sec}$

APPLICATIONS

- Professional Audio Equipment
- Instrumentation and Servo Control
- Telephone Channel Amplifier
- Low-Level Signal Processing
- Audio Pre amplification

ORDER INFORMATION

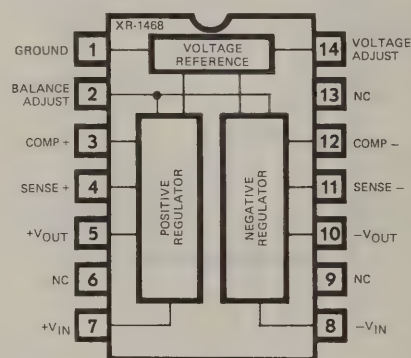
Part Number	Package	Operating Temperature
XR-5534M	Ceramic	-55°C to $+125^\circ\text{C}$
XR-5534CN	Ceramic	0°C to $+75^\circ\text{C}$
XR-5534CP	Plastic	0°C to $+75^\circ\text{C}$

Voltage Regulators

XR-1468/1568 DUAL-POLARITY TRACKING VOLTAGE REGULATOR

The XR-1568/1468 is a dual-polarity tracking voltage regulator combining two separate regulators with a common reference element in a single monolithic circuit, thus providing very close balance between the positive and negative output voltages. Outputs are internally set to ± 15 volts but can be externally adjusted between ± 8.0 to ± 20 volts with a single control. The circuit features $\pm 100 \text{ mA}$ output current, externally adjustable current limiting, and provision for remote voltage sensing.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Internally Set for $\pm 15\text{V}$ Outputs
- $\pm 100 \text{ mA}$ Peak Output Current
- Output Voltages Balanced Within 1% (XR-1568)
- 0.06% Line and Load Regulation
- Low Stand-By Current
- Output Externally Adjustable from ± 14.5 to ± 20 Volts
- Externally Adjustable Current Limiting
- Remote Sensing

APPLICATIONS

- Main Regulation in Small Instruments
- On-Card Regulation in Analog and Digital Systems
- Point-of-Load Precision Regulation

ORDER INFORMATION

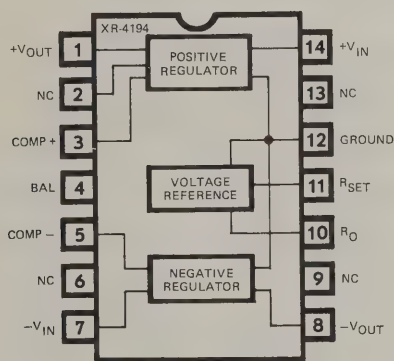
Part Number	Package	Operating Temperature
XR-1568M	Ceramic	-55°C to $+125^\circ\text{C}$
XR-1568N	Ceramic	0°C to $+75^\circ\text{C}$
XR-1468CN	Ceramic	0°C to $+75^\circ\text{C}$

Voltage Regulators

XR-4194 DUAL-TRACKING VOLTAGE REGULATOR

The XR-4194 is a dual-polarity tracking regulator designed to provide balanced or unbalanced positive and negative output voltages at currents up to 200 mA. It features a single resistor to adjust both outputs between the limits of +50 mV and +42V. It is ideal for local "on-card" regulation in analog and digital systems as well as in small instruments.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for RM/RC-4194
- Both Outputs Adjust with Single Resistor
- Load Current to ± 200 mA with 0.2% Load Regulation
- Low External Parts Count
- Internal Thermal Shutdown at $T_j = 175^\circ\text{C}$
- External Adjustment for $\pm V_O$ Unbalancing

APPLICATIONS

- On-Card Regulation in Analog and Digital Systems
- Main Regulation in Small Instruments
- Point-of-Load Precision Regulation

ORDER INFORMATION

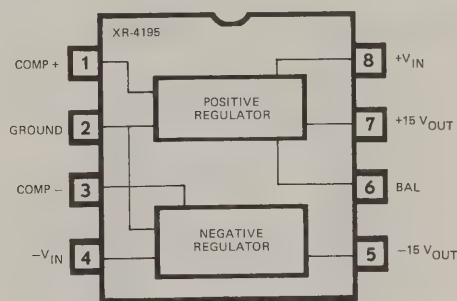
Part Number	Package	Operating Temperature
XR-4194M	Ceramic DIP	-55°C to $+125^\circ\text{C}$
XR-4194CN	Ceramic DIP	0°C to $+75^\circ\text{C}$

XR-4195 $\pm 15\text{V}$ DUAL-TRACKING VOLTAGE REGULATOR

The XR-4195 is a dual-polarity tracking regulator designed to provide balanced positive and negative 15V output voltages at currents of up to 100 mA.

The device is ideal for local "on-card" regulation, which eliminates the distribution problems associated with single-point regulation. Intended for ease of application, the XR-4195 requires only two external components for operation.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for RM/RC-4195
- $\pm 15\text{V}$ Operational Amplifier Power
- Thermal Shutdown at $T_j = 175^\circ\text{C}$
- Output Currents to 100 mA
- Available in 8-Pin Plastic Mini-DIP
- Low External Parts Count

APPLICATIONS

- On-Card Regulation
- Main Regulation in Small Instruments

ORDER INFORMATION

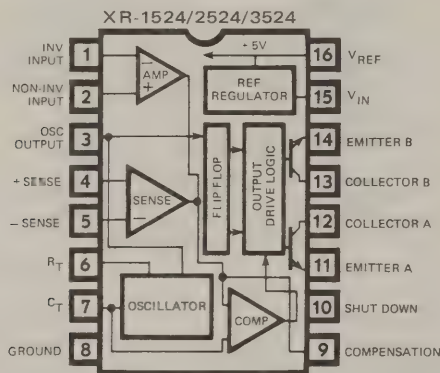
Part Number	Package	Operating Temperature
XR-4195CP	Plastic	0°C to $+70^\circ\text{C}$

Voltage Regulators

XR-1524/2524/3524 PULSE WIDTH MODULATING REGULATOR

This monolithic integrated circuit contains all the control circuitry for a regulating power supply inverter or switching regulator. Included in a 16-pin dual-in-line package is the voltage reference, error-amplifiers, oscillator, pulse-width modulator, pulse-steering flip-flop, dual alternating output switches and current-limiting and shut-down circuitry. This device can be used for switching regulators of either polarity, transformer coupled DC to DC converters, transformer-less voltage doublers and polarity converters, as well as other power control applications. The XR-1524 is specified for operation over the full military temperature range of -55°C to $+125^{\circ}\text{C}$, while the XR-2524 and XR-3524 are designed for commercial applications of 0°C to $+70^{\circ}\text{C}$.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for SG1524/2524/3524
- Complete PWM Power Control Circuitry
- Single-Ended or Push-Pull Outputs
- Lines and Load Regulation of 0.2%
- 1% Maximum Temperature Variation
- Total Supply Current Less than 10 mA
- Operation Beyond 100 kHz

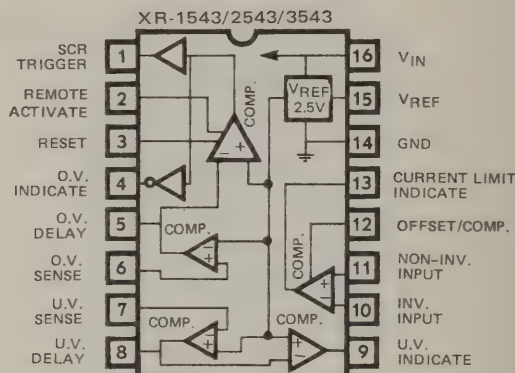
ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-1524M	Ceramic	-55°C to $+125^{\circ}\text{C}$
XR-2524N	Ceramic	0°C to $+75^{\circ}\text{C}$
XR-2524P	Plastic	0°C to $+75^{\circ}\text{C}$
XR-3524CN	Ceramic	0°C to $+75^{\circ}\text{C}$
XR-3524CP	Plastic	0°C to $+75^{\circ}\text{C}$

XR-1543/2543/3543 POWER SUPPLY CONTROL CIRCUIT

This monolithic integrated circuit contains all of the control and supervisory functions necessary to monitor sophisticated power supply and regulator systems. Contained on the monolithic chip are programmable over- and under-voltage sensing circuits, SCR "crowbar" shutdown drive and an independent precision voltage reference generator. All control functions are open-collector type outputs which can be used independently or can be interconnected in a wired-OR configuration.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for SG1543/SG2543/SG3543
- Contains all Control Circuitry on Single Chip
- Over- and Under-Voltage Sensing
- Over-Current Sensing and Shutdown
- Precision Reference Voltage (1% Accuracy)
- SCR "Crowbar" Drive (200 mA)
- Remote Control Capability
- Low Stand-By Current (Less than 10 mA)

APPLICATIONS

- Complex Power Supply Control:
- Computer and Memory Systems
- Computer Peripherals
- Switching Regulator Systems
- Electro-Mechanical Controller

ORDER INFORMATION

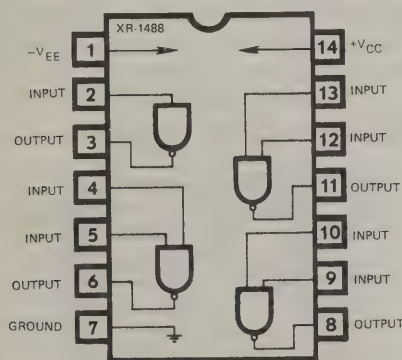
Part Number	Package	Operating Temperature
XR-1543M	Ceramic	-55°C to $+125^{\circ}\text{C}$
XR-2543N	Ceramic	0°C to $+75^{\circ}\text{C}$
XR-2543P	Plastic	0°C to $+75^{\circ}\text{C}$
XR-3543CN	Ceramic	0°C to $+75^{\circ}\text{C}$
XR-3543CP	Plastic	0°C to $+75^{\circ}\text{C}$

Line Interface Circuits

XR-1488 QUAD LINE DRIVER

The XR-1488 is a monolithic quad line driver designed to interface data terminal equipment with data communications equipment. It meets EIA Standard No. RS232C. This circuit features output current limiting, independent positive and negative power supply driving elements, and compatibility with all DTL and TTL logic families.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for MC1488
- Current Limited Output
- Compatible with DTL and TTL Logic
- Meets EIA Standard RS232C

APPLICATIONS

- Data-Terminal Interface
- Driving Capacitive Loads
- Data Bus Interface

ORDER INFORMATION

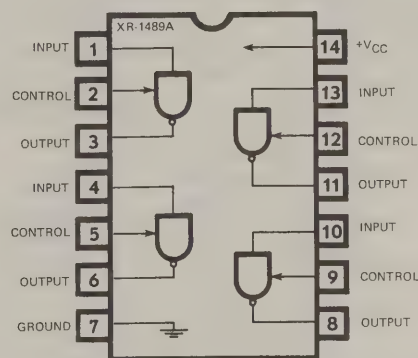
Part Number	Package	Operating Temperature
XR-1488N	Ceramic	0°C to +75°C
XR-1488P	Plastic	0°C to +75°C

XR-1489A QUAD LINE RECEIVER

The XR-1489A is a monolithic quad line receiver especially designed for data bus interface. Each of the line receiver sections have adjustable hysteresis characteristics for improved noise-rejection. The input and output levels of the circuit are designed to provide direct interface between RS232C data bus standards and the DTL or TTL type logic levels.

The XR-1489A line receiver and the XR-1488 line driver circuits are designed to provide the complete interface function between terminal equipment and the data communication or telemetry systems.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for MC1489A
- Current Limited Output
- Compatible with DTL and TTL Logic
- Meets EIA Standard RS232C

APPLICATIONS

- Data-Bus Interface
- Microprocessor Interface
- Remote Terminal Interface

Part Number	Package	Operating Temperature
XR-1489AN	Ceramic	0°C to +75°C
XR-1489AP	Plastic	0°C to +75°C

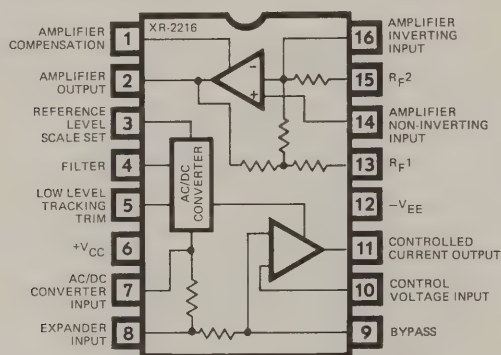
Telecommunication Circuits

XR-2216 MONOLITHIC COMPANDOR

The XR-2216 is a monolithic audio frequency compandor designed to compress or expand the dynamic range of speech or other analog signals transmitted through telecommunication systems. External circuitry determines whether the circuit is connected as either a compressor or an expander.

The circuit features four basic blocks: (1) an internal voltage reference, (2) an AC/DC converter, (3) an impedance converter, and (4) a high-gain operational amplifier. The XR-2216 can be operated with positive or negative single supply systems or dual power supplies over a 6V to 20V power supply range.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Functions as Either a Compressor or an Expander
- Wide Dynamic Range: 60 dB
- Wide Supply Range: 6 to 20 Volts
- Excellent Transfer Function Tracking
- Low Power Supply Drain
- Controlled Attack and Release Times
- Low Noise and Low Distortion

APPLICATIONS

- Telephone Trunk-Line Compandor
- Speech/Data Compression and Expansion
- Telecommunications Systems
- Mobile Communications
- Analog Data Processing

ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-2216CN	Ceramic	-40°C to +60°C
XR-2216CP	Plastic	-40°C to +60°C

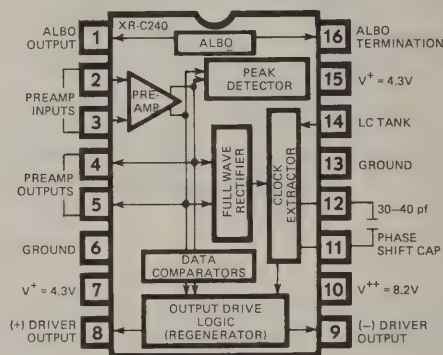
XR-C240 MONOLITHIC PCM REPEATER

The XR-C240 is a monolithic repeater circuit for Pulse-Code Modulated (PCM) telephone systems. It is designed to operate as a regenerative repeater at 1.544 Megabits per second (Mbps) data rates on T-1 type PCM lines.

The XR-240 monolithic IC is packaged in a hermetic 16-pin DIP package and is designed to operate over a temperature range of -40°C to +85°C. It contains all the basic functional blocks of a regenerative repeater system including Automatic Line Build-Out (ALBO) and equalization, and is insensitive to reflections caused by cable discontinuities.

Compared to conventional repeater designs using discrete components, the XR-C240 monolithic repeater IC offers greatly improved reliability and performance and provides significant savings in power consumption and system cost.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Contains all Active Components of PCM Repeater
- On-Chip ALBO Equalizer
- High-Current Output Drivers
- Low-Power Consumption
- Increased Reliability over Discrete Designs
- 2 Megabit Operation Capability

APPLICATIONS

- PCM Repeater for T-1 Systems
- Repeater for 2 Megabit PCM Systems

ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-C240	Ceramic	-40°C to +85°C

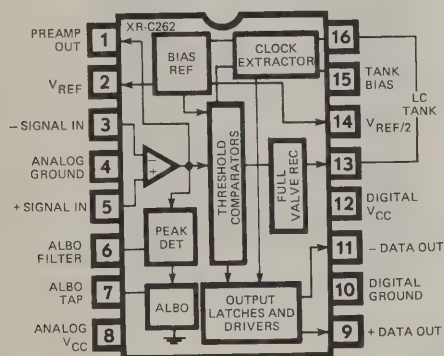
Telecommunication Circuits

XR-C262 HIGH-PERFORMANCE PCM REPEATER

The XR-C262 is a high-performance monolithic repeater IC for pulse-code modulated (PCM) telephone lines. It is designed to operate as a regenerative repeater at 1.544 Megabits per second (Mbps) data rates on T-1 type PCM lines.

The XR-C262 operates with a single 6.8 volt power supply and with a typical supply current of 13 mA. It provides bipolar output drive with high-current handling capability. The clock-extractor section of XR-262 uses the resonant-tank circuit principle, rather than the injection-locked oscillator technique used in earlier monolithic repeater designs. The bipolar output drivers are designed to go "off" state automatically when there is no input signal present.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Contains all Necessary Active Components of a PCM Repeater
- Uses L-C Tank for Clock Recovery
- Low-Voltage Operation (6.8 volts)
- Low-Current Drain (13 mA, typical)
- High-Current Bipolar Output Drivers
- On-Chip ALBO Equalizer
- Automatic Zero-Input Shutdown
- Increased Reliability Over Discrete Designs
- 2 Megabit Operation Capability

APPLICATIONS

- PCM Repeater for T-1 Systems
- Repeater for 2 Megabit PCM Systems

ORDER INFORMATION

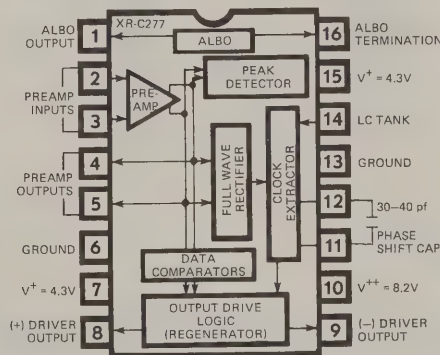
Part Number	Package	Operating Temperature
XR-C262	Ceramic	-40°C to +85°C

XR-C277 LOW-VOLTAGE PCM REPEATER

The XR-C277 is a monolithic repeater circuit for Pulse-Code Modulated (PCM) telephone systems. It is designed to operate as a regenerative repeater at 1.544 Megabits per second (Mbps) data rates on T-1 type PCM lines. It is packaged in a hermetic 16-pin Cerdip package and is designed to operate over a temperature range of -40°C to +85°C. It contains all the basic functional blocks of a regenerative repeater system including Automatic Line Build-Out (ALBO) and equalization, and is insensitive to reflections caused by cable discontinuities.

The key feature of the XR-C277 is its ability to operate with low supply voltages (6.3 volts and 4.3 volts) with a supply current of less than 13 mA. Compared to conventional repeater designs using discrete components, the XR-C277 monolithic repeater IC offers greatly improved reliability and performance and provides significant savings in power consumption and system cost.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Contains all Active Components of PCM Repeater
- Low-Voltage Operation (6.3 volts)
- Low-Power Dissipation (13 mA)
- On-Chip ALBO Equalizer
- High-Current Output Drivers
- Increased Reliability over Discrete Designs
- 2 Megabit Operation Capability
- Pin-Compatible with XR-C240

APPLICATIONS

- PCM Repeater for T-1 Systems
- Repeater for 2 Megabit PCM Systems

ORDER INFORMATION

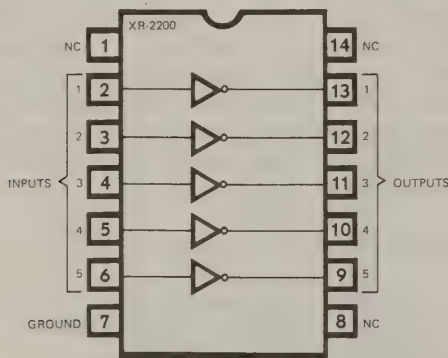
Part Number	Package	Operating Temperature
XR-C277	Ceramic	-40°C to +85°C

High Current Drivers

XR-2200 HAMMER DRIVER

The XR-2200 is an array of five Darlington transistor pairs which are capable of driving high-current loads such as solenoids, relays, and LED's. Each of the five circuits contained on the XR-2200 is capable of sinking up to 400 mA. The XR-2200 was specifically designed for use with 14V to 25V PMOS devices.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Output Capability of 400 mA for each Driver
- Drivers May be Used in Parallel for Increased Output Drive Capability
- Input is Directly Compatible with PMOS Outputs

APPLICATIONS

- Printing Calculator Hammer Driver
- High Current LED Driver
- Solenoid and Relay Driver
- Tungsten Lamp Driver
- High Current Switch

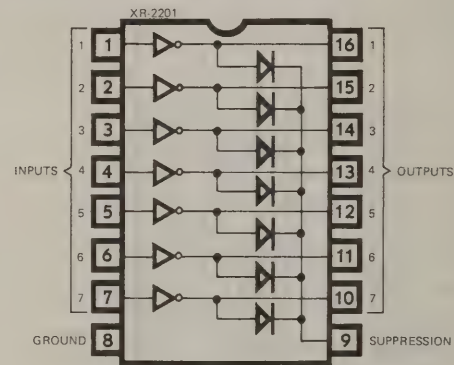
ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-2200CP	Plastic	-25°C to +75°C

XR-2201/2202/2203/2204 HIGH-VOLTAGE, HIGH-CURRENT DARLINGTON TRANSISTOR ARRAYS

The XR-2201/2202/2203/2204 Darlington transistor arrays are comprised of seven silicon NPN Darlington pairs on a single monolithic substrate. All feature open-collector outputs and internal protection diodes for driving inductive loads. Peak inrush currents of up to 600 mA are allowable, making them also ideal for driving tungsten filament lamps. Although the maximum continuous collector current rating is 500 mA for each driver, the outputs may be paralleled to achieve higher load current capability.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- High Peak Current Capability: 600 mA
- Internal Protection Diodes for Driving Inductive Loads
- Directly Compatible with TTL, CMOS, PMOS, and DTL Logic Families
- Exact Replacement for Sprague Types ULN2001A, ULN2002A, ULN2003A, and ULN2004A

APPLICATIONS

- Solenoid and Relay Driver
- High Current LED Driver
- Printing Calculator Hammer Driver
- High Current Switch
- Tungsten Lamp Driver

ORDER INFORMATION

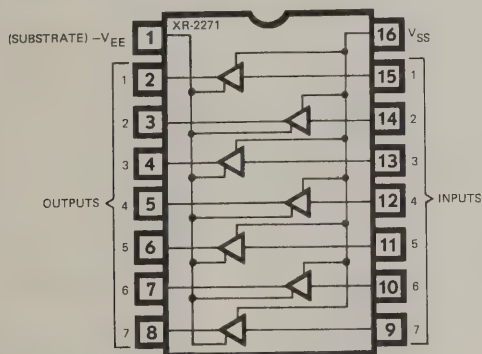
Part Number	Package	Operating Temperature
XR-2201CP	Plastic	0°C to +85°C
XR-2202CP	Plastic	0°C to +85°C
XR-2203CP	Plastic	0°C to +85°C
XR-2204CP	Plastic	0°C to +85°C

Display Drivers

XR-2271 FLUORESCENT DISPLAY DRIVER

The XR-2271 is a monolithic 7-digit or 7-segment driver designed to interface MOS logic with fluorescent displays. The circuit features active high logic and low input current and it can drive all seven digits with complete input and output isolation. No external parts are necessary to interface fluorescent displays.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Active High Logic
- Low Input Current
- Complete Input Output Isolation
- Output Pull Up Resistors On Chip
- No External Parts Required to Drive Fluorescent Displays

APPLICATIONS

Fluorescent Display Driver
MOS Logic/High-Voltage Interface

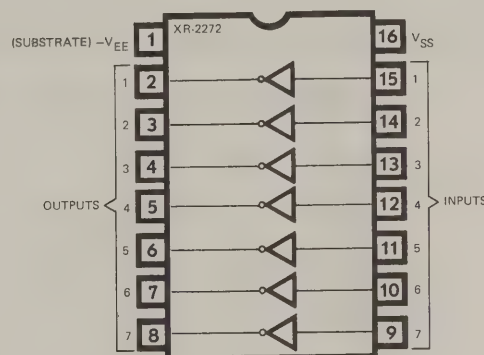
ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-2271CN	Ceramic	0°C to +75°C
XR-2271CP	Plastic	0°C to +75°C

XR-2272 HIGH-VOLTAGE 7-DIGIT DISPLAY DRIVER

The XR-2272 is a monolithic high-voltage 7-digit driver specifically designed to drive a gas-filled digit display. The main application is to act as buffers between MOS outputs and the anodes of a gas discharge panel.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Active Low Inputs
- Versatile Circuits for a Wide Range of Display Applications
- High Breakdown Voltages
- Low Power Dissipation
- 16-Pin Dual-in-Line Plastic Package

APPLICATIONS

Gas-Discharge Display Driver
Panaplex® Display Driver
MOS Logic to High-Voltage Interface

ORDER INFORMATION

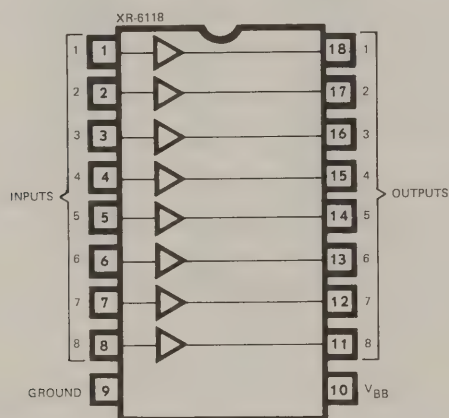
Part Number	Package	Operating Temperature
XR-2272CP	Plastic	0°C to +75°C

Display Drivers

XR-6118 FLUORESCENT DISPLAY DRIVER

The XR-6118 is a high-voltage monolithic IC consisting of eight NPN Darlington Output stages, along with their common-emitter type input stages. The circuit is designed to interface between low-level digital logic and high-voltage vacuum fluorescent displays. The XR-6118 is capable of driving the digits and/or segments of these displays and are designed to permit all eight outputs to be activated simultaneously. Pulldown resistors are incorporated into each output and no external components are required for most fluorescent display applications. It is directly compatible with standard or Schottky TTL, DTL, and 5-volt CMOS logic families.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for Sprague UDN-6118A
- Digit or Segment Drivers
- Low Input Current
- Integral Output Pulldown Resistors
- Low Power
- Reliable Monolithic Construction
- High Output Breakdown Voltage

APPLICATIONS

- Fluorescent Driver
- Gas-Discharge Display Driver
- High-Voltage Switching

ORDER INFORMATION

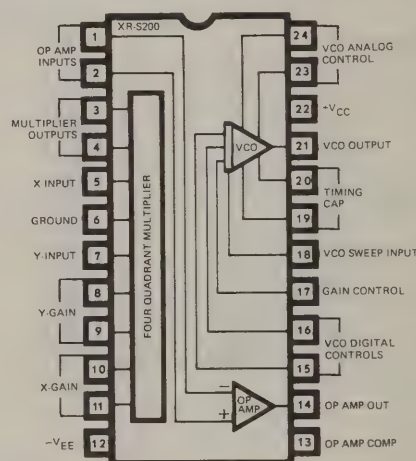
Part Number	Package	Operating Temperature
XR-6118N	Ceramic	0°C to +85°C
XR-6118P	Plastic	0°C to +85°C

Special Functions

XR-S200 MULTI-FUNCTION INTEGRATED CIRCUIT

The XR-S200 integrated circuit is a highly versatile, multi-purpose circuit that contains all of the essential functions of most communication system designs on a single monolithic substrate. The functions contained in the XR-S200 include: (1) a four quadrant analog multiplier, (2) a high frequency voltage controlled oscillator (VCO) and (3) a high performance operational amplifier. The three functions can be used independently, or directly interconnected in any order to perform a large number of complex circuit functions from phase-locked loops to the generation of complex waveforms.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Three Independent Circuit Functions:
 - A Four Quadrant Analog Multiplier
 - A High Frequency Voltage Controlled Oscillator (VCO)
 - A High Performance Operational Amplifier
- Analog and Digital Signal Conditioning
- A Frequency Range of 0.1 Hz to 30 MHz
- A Power Supply Range of $\pm 3V$ to $\pm 30V$

APPLICATIONS

- Phase-Locked Loops
- FM Demodulation
- FSK Detection
- Signal Conditioning
- Tracking Filters
- Frequency Synthesis
- Telemetry Coding/Decoding
- Linear Sweep/FM Waveform Generation

ORDER INFORMATION

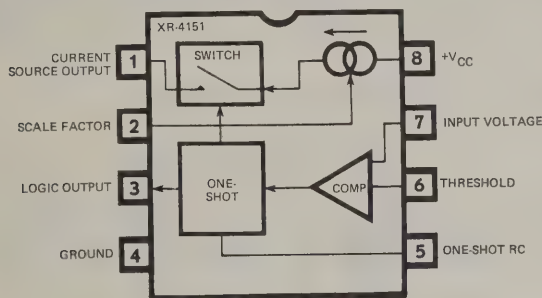
Part Number	Package	Operating Temperature
XR-S200	Ceramic	0°C to +75°C

Special Functions

XR-4151 VOLTAGE-TO-FREQUENCY CONVERTER

The XR-4151 is a device designed to provide a simple, low-cost method for converting a DC voltage into a proportional pulse repetition frequency. It is also capable of converting an input frequency into a proportional output voltage. The XR-4151 is useful in a wide range of applications including A/D and D/A conversion and data transmission.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Single Supply Operation (+8V to +22V)
- Pulse Output Compatible with all Logic Forms
- Programmable Scale Factor
- Linearity $\pm 0.05\%$ typical (precision mode)
- Temperature Stability $\pm 100\%$ ppm/ $^{\circ}\text{C}$ typical
- High Noise Rejection
- Inherent Monotonicity
- Easily Transmittable Output
- Simple Full-Scale Trim
- Single-Ended Input
- Also Provides Frequency-to-Voltage Conversion
- Direct Replacement for RC/RV/RM-4151

APPLICATIONS

- Voltage-to-Frequency Conversion
- A/D and D/A Conversion
- Data Transmission
- Frequency-to-Voltage Conversion
- Transducer Interface
- System Isolation

ORDER INFORMATION

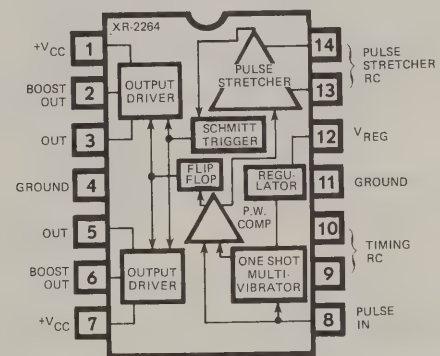
Part Number	Package	Operating Temperature
XR-4151P	Plastic	-40°C to $+85^{\circ}\text{C}$
XR-4151CP	Plastic	0°C to $+70^{\circ}\text{C}$

XR-2264/2265 PULSE-PROPORTIONAL SERVO CIRCUIT

The XR-2264/2265 are monolithic circuits designed for use in pulse-proportional servo systems and specifically designed for radio control applications. They are capable of controlling positions in direct proportion to the width of input pulses.

The XR-2264 can interface directly with servo motors requiring up to 350 mA of drive current. The XR-2265, with open collector outputs, can directly drive relays, optical couplers, and triacs. Both circuits can drive external PNP transistors for 500 mA output drive requirements. The XR-2264/2265, combined with a servo motor and a feedback potentiometer, form a closed-loop system.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Wide Supply Voltage Range (3.0V to 6.0V)
- Bidirectional Operation with Single Supply
- Separately Adjustable Dead Band and Pulse Stretching
- XR-2264 — 350 mA Source and Sink on Chip
- 500 mA with External PNP
- XR-2265 — 500 mA Sink Capability on Chip
- 500 mA Sink or Source Capability with External PNP

APPLICATIONS

- Radio Control
- Remote Control
- Servo Driver

ORDER INFORMATION

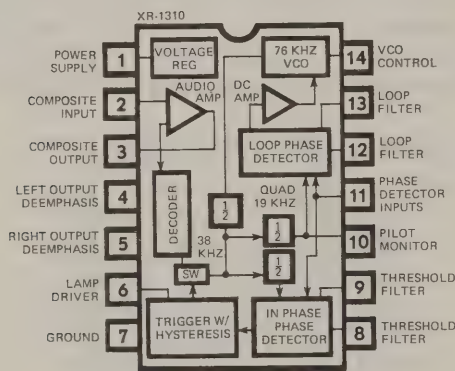
Part Number	Package	Operating Temperature
XR-2264CP	Plastic	-10°C to $+50^{\circ}\text{C}$
XR-2265CP	Plastic	-10°C to $+50^{\circ}\text{C}$

Special Functions

XR-1310 STEREO DEMODULATOR

The XR-1310 is a unique FM stereo demodulator which uses phase-locked loop techniques to extract the right and the left audio channels from the composite signal. Using a phase-locked loop to regenerate the 38 kHz subcarrier, it requires no external L-C circuit for tuning. Alignment is accomplished with a single potentiometer.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Requires No Inductors
- Low External Part Count
- Simple, Noncritical Tuning by Single Potentiometer Adjustment
- Internal Stereo/Monaural Switch with 100 mA Lamp Driving Capability
- Wide Dynamic Range: 600 mV (RMS) Maximum Composite Input Signal
- Wide Supply Voltage Range: 8 to 14 Volts
- Excellent Channel Separation
- Low Distortion
- Excellent SCA Rejection

APPLICATIONS

FM Stereo Demodulation

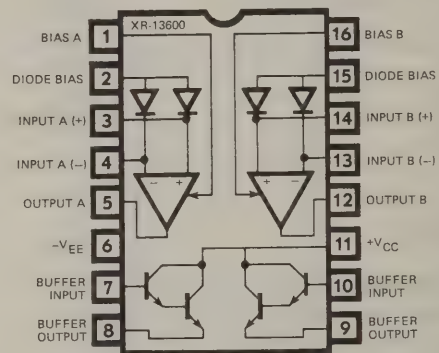
ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-1310CP	Plastic	-40°C to +85°C

XR-13600 DUAL OPERATIONAL TRANSCONDUCTANCE AMPLIFIER

The XR-13600 consists of 2 programmable transconductance amplifiers with high input impedance and push-pull outputs. The 2 amplifiers share common supplies but otherwise operate independently. Each amplifier's transconductance is directly proportional to its applied bias current. To improve signal-to-noise performance, predistortion diodes are included on the inputs; the use of these diodes results in a 10 dB improvement referenced to 0.5% THD. Independent Darlington emitter followers are included to buffer the outputs.

FUNCTIONAL BLOCK DIAGRAM



FEATURES

- Direct Replacement for LM-13600
- Transconductance Adjustable Over 4 Decades
- Excellent Transconductance-Control Linearity
- Uncommitted Darlington Output Buffers
- On-Chip Predistortion Diodes
- Excellent Matching Between Amplifiers
- Wide Supply Range: $\pm 2V$ to $\pm 18V$

APPLICATIONS

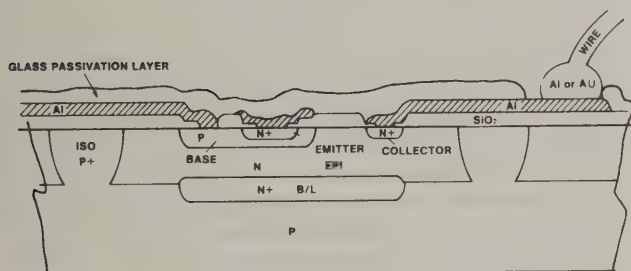
- Current-Controlled Amplifiers
- Current-Controlled Impedances
- Current-Controlled Filters
- Current-Controlled Oscillators
- Multipliers/Attenuators
- Sample and Held Circuits
- Electronic Music Synthesis

ORDER INFORMATION

Part Number	Package	Operating Temperature
XR-13600CP	Plastic	0°C to +75°C

Monolithic Chips for Hybrid Assemblies

The major performance characteristics of Exar products are also available in chip form. All chips are 100% electrically tested for guaranteed DC parameters at 25°C; and 100% visually inspected at 30x to 100x magnification using Exar's standard visual inspection criteria or MIL-STD-883, Method 201, depending on the individual customer requirements. Each chip is protected with an inert glass passivation layer over the metal interconnections. The chips are packaged in waffle-pack carriers with an anti-static shield and cushioning strip plated over the active surface to assure protection during shipment. All chips are produced on the same well-proven production lines that produce Exar's standard encapsulated devices. The Quality Assurance testing of dice is provided by normal production testing of packaged devices.



Typical Bipolar Chip Cross Section

FEATURES

- DC Parameters Guaranteed at 25°C
- 100% Visual Inspection
- Care in Packaging
- 100% Stabilization Bake (Wafer Form)
- 10% LTPD on DC Electrical Parameters

CHIPS IN WAFER FORM

Probed and inked wafers are also available from Exar. The hybrid microcircuit designer can specify either scribed or unscribed wafers and receive a fully tested silicon wafer. Rejected die are clearly marked with an ink dot for easy identification in wafer form.

ELECTRICAL PARAMETERS

Probing the IC chips in die form limits the electrical testing to low level DC parameters at 25°C. These DC parameters are characteristic of those parameters contained on the individual device data sheet and are guaranteed to an LTPD of 10%.

The AC parameters, which are similar to those in the standard Exar device data sheets, have been correlated to selected DC probe parameters and are guaranteed to an LTPD of 20%.

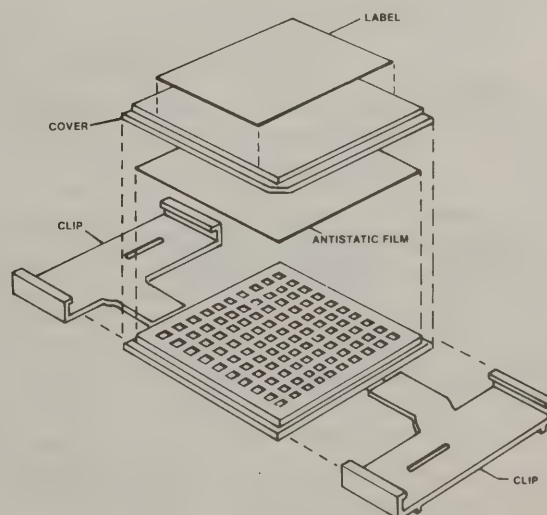
HANDLING PRECAUTIONS AND PACKAGING OPTIONS

Extreme care must be used in the handling of unencapsulated semiconductor chips or dice to avoid damage to the chip surface. Exar offers the following three handling or packaging options for monolithic chips supplied to the customer:

Cavity or Waffle Pack: The dice are placed in individual compartments of the waffle pack (see figure). The plastic snap clips permit inspection and resealing.

Vial Pack: The vial is filled with inert freon TF and a plastic cap seals the vial. The freon acts as a motion retarder and cleansing agent.

Wafer Pack: The entire wafer is sandwiched between two pieces of mylar and vacuum sealed in a plastic envelope.



Typical Cavity Pack
(Waffle Pack)

Semi-custom Bipolar Program

The Exar bipolar semi-custom design program offers a variety of "semi-custom" chips to fulfill various application performance requirements and complexities.

These semi-custom chips offer a unique method of manufacturing an almost unlimited variety of custom linear and digital integrated circuits with greatly reduced cost and development time. Exar makes this possible by stocking wafers that are completely fabricated except for the final process step of device interconnection which metalizes the selected components together in the required circuit configurations.

BIPOLAR SEMI-CUSTOM CHIPS

Chip Type	Chip Size in Mils	Breakdown Voltage	NPN	PNP
A100	73 X 83	22V	60	18
B100	85 X 85	22V	69	12
C100	87 X 78	28V	48	10
D100	80 X 80	36V	50	16*
+F100	91 X 110	22V	97	32*

+Presently under development

*Dual collector PNP transistors

Exar offers a design kit which contains simple instructions and guidelines for designing the metal mask as well as actual breadboard components (consisting of NPN and PNP arrays and integrated resistors), which are representative of the devices available on the semi-custom chips. This provides the design engineer with the ability to closely evaluate his design performance prior to integrating it on a monolithic chip.

Semi-custom I²L Program

With the introduction of the I²L Gate-Array chips, Exar has extended its semi-custom design program to the Integrated Injection Logic (I²L) technology. This unique method of custom LSI development technique now makes it possible to manufacture an almost unlimited variety of digital or analog/digital circuits using I²L technology, at a greatly reduced development cost and time.

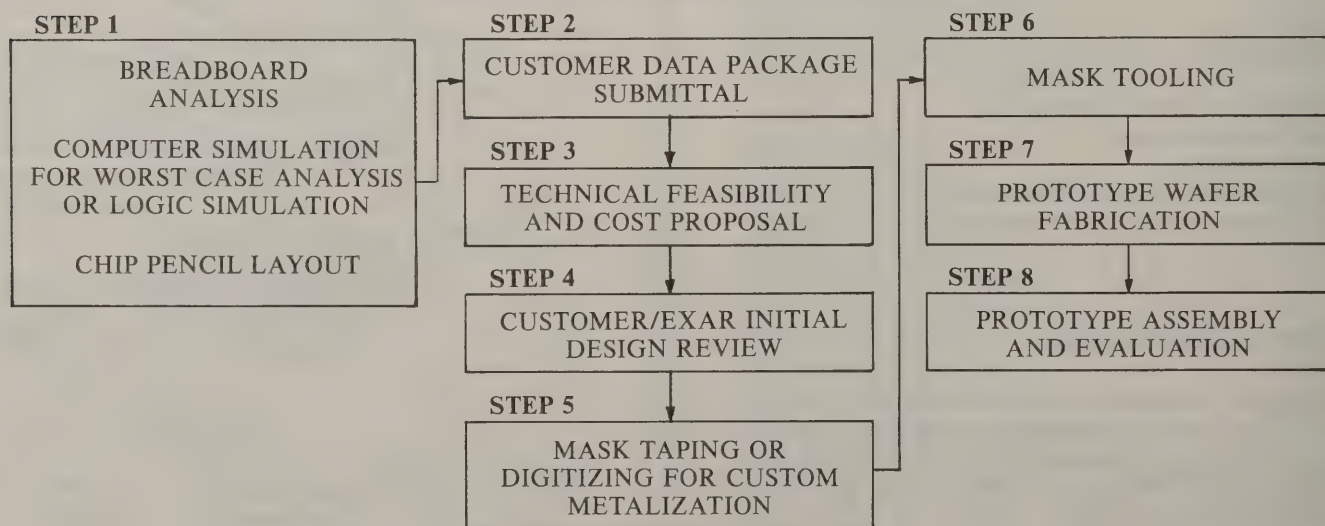
I²L SEMI-CUSTOM CHIPS

Characteristics	Chip Type		
	XR-300	XR-400	XR-500
Chip Size (mils)	104 X 140	111 X 111	122 X 185
I ² L Gates	288	272	520
Max. Operating Voltage			
A-Option	6V	6V	6V
B-Option	15V	15V	15V
Bipolar I/O Interfaces	28	38	40
Bonding Pads	34	38	42

The XR-300 and the XR-500 gate-arrays are intended primarily for digital LSI designs. The XR-400 gate-array features the advantages of combining analog and digital functions on the same IC chip. These I²L gate-array chips are customized using two or more custom mask patterns which are simultaneously generated from a pencil layout, using Exar's unique computerized mask generation technique. In this manner, the chip layout is greatly simplified and gate-utilization efficiency is increased.

Exar also offers an I²L design kit which is intended to familiarize the designer with the basic features of I²L technology and provide helpful design guidelines in reducing his design from concept to breadboard and finally to the IC layout stage.

TYPICAL FLOW FOR SEMI-CUSTOM DEVELOPMENT



Full Custom Development

Exar offers a complete design and production capability for full-custom IC development using Exar's bipolar and I²L technologies. This provides an excellent complement to Exar's unique semi-custom capability.

Exar's full-custom IC development and production capabilities offer complete flexibility to meet changing customer needs or design problems. We can develop a complete custom IC starting from your "black-box" specifications or reduce your working breadboard prototype to a monolithic chip. Alternately, if you have the facilities and resources to do the IC design and the layout, Exar will provide you with the device characteristics and IC layout rules for the particular process suitable to your design and review your IC layout for you. Then, Exar can generate the IC tooling and fabricate your IC prototypes for you.

Exar's bipolar process technology is compatible with the manufacturing processes available from many of the other IC manufacturers. Thus, if you have developed a set of IC tooling with another manufacturer and would like an alternate or substitute supplier for your custom IC product, in most cases your existing IC tooling may be directly compatible with Exar's technology.

Exar's Engineering Department has two custom IC design groups dedicated to the development of linear and digital custom LSI. We pride ourselves in our flexibility and quick response to your needs.

CONVERTING SEMI-CUSTOM TO FULL CUSTOM

Exar offers the unique ability to start a program using a combination of semi-custom bipolar and/or I²L arrays during the early phases of a customer's product, taking full advantage of the low tooling cost and short development cycle. As a customer's product matures and its market expands, resulting in higher volume production run rates, Exar can convert the multiple semi-custom chip approach into a single custom IC, achieving a cost reduction and in many cases, a performance improvement. The significant advantage of this type of program is that the risk associated with a custom development is greatly reduced; the IC design approach has been proven, production "bugs" are out of your product and your production line continues to flow during the full custom chip development. Once the custom chip is completely characterized and found acceptable, the semi-custom IC system in your product can be phased-out while the full-custom IC is being phased-in.

Exar is the only company that can offer you the advantages of semi-custom and full-custom bipolar design programs because of our in-house complete semiconductor manufacturing capability.

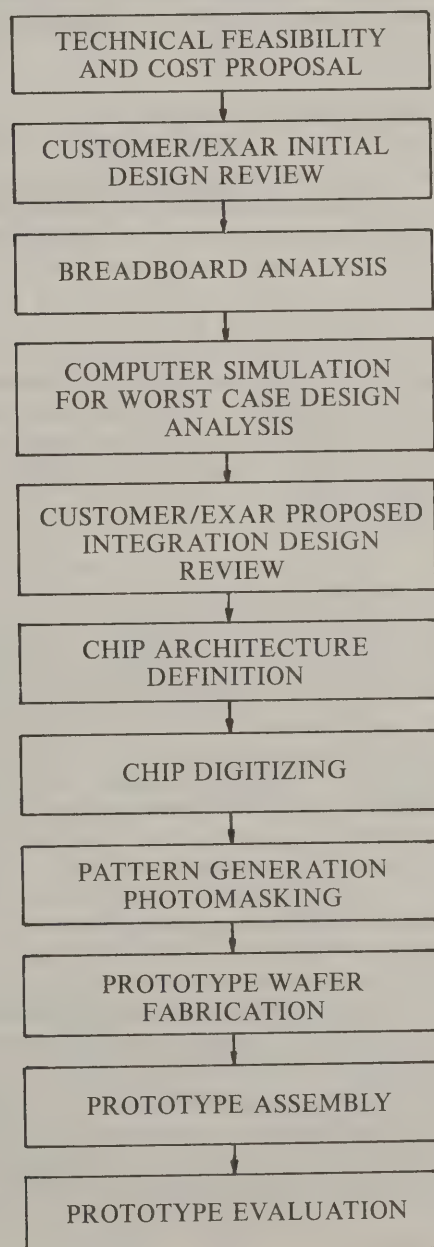
YOUR FIRST STEP

The following technical data package is required in order for Exar to provide you with a firm quotation for your full-custom development program:

1. Circuit block diagram with sub-blocks (as required).

2. Circuit Schematic or Logic Diagram.
3. Description of circuit operation and pertinent application information.
4. Preliminary or objective device specification indicating min/max conditions and limits for the critical parameters (i.e., input/output voltage and current levels, operating frequency, timing diagrams, input/output impedances, power dissipation, etc.)
5. Production requirements and the desired development time table.

FLOW-CHART OF TYPICAL FULL CUSTOM DEVELOPMENT PROGRAM



Application Notes

Exar's Applications Engineering Department has prepared a comprehensive set of application notes and information in Exar's products and technologies. A list of these application notes, along with a brief description of their contents, is given below:

AN-01: Stable FSK Modems Featuring the XR-2206, XR-2207 and XR-2211

Design of stable full-duplex FSK modems is described using the XR-2206 or the XR-2207 as the modulator, and the XR-2211 as the demodulator with carrier-detection capability. Complete design examples are given for FSK modems covering mark/space frequencies from a few Hertz to 100 KHz.

AN-02: XR-C240 Monolithic PCM Repeater

The principle of operation of the XR-C240 monolithic regenerative repeater IC is described. Design examples and external connections of the circuit are discussed for applications in T-1 type 1.544 Megabit PCM telephone lines.

AN-03: Active Filter Design With IC Op Amps

Fundamentals of active filters are discussed, transfer functions and design equations for various classes of high-, low- and bandpass filters are given. Particular design examples are provided for FSK modem filters, using the XR-4202 programmable quad op amp.

AN-04: XR-C277 Low-Voltage PCM Repeater IC

The design principles and the applications of the XR-C277 low-voltage (6.3 volt) regenerative PCM repeater are described. The monolithic IC contains all the basic functional blocks of a conventional PCM repeater, including the automatic line build-out section. Circuit connection diagrams and application examples are given for operation in 1.544 Megabit T-1 type PCM telephone systems.

AN-05: Tri-State FSK Modem Design Using XR-2206/XR-2211

Design of FSK modems with carrier detection and control capability are discussed. Such a "tri-state" modem uses a third carrier frequency for control functions, in addition to the normal "mark" and "space" frequencies used in conventional "bi-state" FSK systems. This carrier control feature allows each transmitter in a modem system to be automatically interrogated, one at a time, by a control processor, without interference from other modem transmitters within the system.

AN-06: Precision PLL System Using XR-2207/XR-2208

A two-chip versatile phase-locked loop system is described, using the XR-2207 oscillator as the VCO, and the XR-2208 multiplier as the phase detector. The resulting PLL system features 20 ppm/ $^{\circ}$ C temperature stability. Design equations are given to tailor the circuit parameters to specific applications.

AN-07: Single-Chip Frequency Synthesizer Employing the XR-2240

The operation of the XR-2240 programmable/counter IC as a frequency synthesizer is described. The circuit can simultaneously multiply an input frequency by an integer modulus M, and divide it by a different modulus N+1. Thus, a wide range of non-integer output frequencies can be produced from a single input reference frequency.

AN-08: Dual-Tone Decoding with XR-567 and XR-2567

Application examples are given for simultaneous or sequential decoding of dual-tone control signals using either two XR-567 PLL tone decoders, or a single XR-2567 dual tone decoder. The examples include high-speed, narrow-band tone detection and Touch-Tone[®] decoding.

AN-09: Sinusoidal Output From XR-215 Monolithic PLL Circuit

A simple circuit technique is described to convert the VCO output of the XR-215 into a low-distortion sinewave. The external sinewave shaping circuit is obtained using the XR-C101 monolithic NPN transistor array.

AN-10: XR-C262 High-Performance PCM Repeater

The design principle and the electrical characteristics of the XR-C262 high-performance PCM repeater IC are described. The circuit contains all the active components necessary for a regenerative PCM repeater system and operates with a single 6.8 volt power supply. Circuit connection and application examples are given for its use in 1.5 Megabit or 2 Megabit PCM systems.

AN-11: A Universal Sinewave Converter Using the XR-2208 and XR-2211

A circuit technique is described which can convert any periodic waveform into a low-distortion sinewave. The circuit operation is completely independent of input waveform amplitude and frequency as long as the input signal is periodic, and can operate over a frequency range of 1 Hz to over 100 KHz.

Application Notes

AN-12: A Wide Tracking Range Precision PLL System Using the XR-2212 and XR-4151

A two-chip PLL system is described which offers extremely wide tracking range without harmonic locking. The system uses the XR-2212 precision PLL along with the XR-4151 voltage/frequency converter, and is ideally suited for motor-speed or tape-drive control applications.

AN-13: Frequency Selective AM Detection Using Monolithic Phase-Locked Loops

Design of frequency selective coherent AM and AM/FM demodulator systems is described using the XR-2228 Multiplier/Detector and the XR-215 or the XR-2212 PLL ICs.

AN-14: A Complete Function Generator System Using the XR-2206

A laboratory quality self-contained function generator system is described, using the XR-2206 waveform generator IC. Complete circuit connection diagram, parts list and assembly instructions are given for a DC to 100 kHz self-contained function generator system with AM/FM capability and triangle, sine and square wave output.

AN-15: An Electronic Music Synthesizer Using the XR-2207 and the XR-2240

Design of a simple, low-cost "music synthesizer" system is described. The electronic music synthesizer is comprised of the XR-2207 voltage controlled oscillator IC which is driven by the pseudo-random binary pulse pattern generated by the XR-2240 counter/timer circuit.

AN-16: Semi-Custom LSI Design with I²L Gate Arrays

A unique design approach to developing complex LSI systems is described using XR-300 and XR-500 I²L gate arrays. This technique greatly reduces the design and tooling cost and the prototype fabrication cycle associated with the conventional full-custom IC development cycle; and thus makes custom ICs economically feasible even at low production volumes.

AN-17: XR-C409 Monolithic I²L Test Circuit

A monolithic test circuit has been developed for evaluation of speed and performance capabilities of Exar's Integrated Injection Logic (I²L) technology. This test circuit, designated the XR-C409, is intended to familiarize the I²L user and the system designer with some of the performance features of I²L such as its frequency capability and power-speed tradeoffs.

Technical Literature

Exar's technical staff and applications engineers have prepared a number of comprehensive Data Books which cover some of the key features and applications of Exar's IC products. These Data Books also present a number of tutorial articles on the fundamentals of such important IC products as operational amplifiers, timers, phase-locked loops voltage-controlled oscillators. These books are available directly from your Exar sales or technical representative.

A brief description of each of these data books is given below:

TIMER DATA BOOK:

This data book provides a collection of technical articles and application information on monolithic timer IC products. Also included are the data sheets and the detailed electrical specifications of all of Exar's timer circuits, including the programmable timer/counters, micropower and long-delay timers. (48 pages)

PHASE-LOCKED LOOP DATA BOOK:

This data book covers the fundamentals of design and applications of monolithic phase-locked loop (PLL) circuits. A long list of PLL applications are illustrated covering FM demodulation, frequency synthesis, FSK and tone detection. Particular emphasis is given to application of PLL circuits in data interface and communication systems such as FSK modems. This book also contains the data sheets and electrical specifications of all of Exar's PLL products. (74 pages)

FUNCTION GENERATOR DATA BOOK:

This comprehensive data book contains a number of technical articles and application notes on monolithic voltage-controlled oscillator (VCO) and function generator IC products. In addition, the data sheets and technical specifications of Exar's monolithic VCO's and function generators are given. (50 pages)

OPERATIONAL AMPLIFIER DATA BOOK:

This book contains a collection of technical articles on the fundamentals of monolithic IC op-amps. Some of the basic op-amp circuits are given, and the applications of IC op-amps in active filter design are discussed. The book also contains a complete set of electrical specifications of Exar's bipolar and BIFET op-amp products. (60 pages)

APPLICATIONS DATA BOOK:

This book contains a complete and up-to-date set of application notes prepared by Exar's technical staff. These application notes cover a wide range of subjects such as FSK modems, active filters, telecommunication circuits, electronic music synthesis and many more. In each case, specific design examples are given to demonstrate the applications discussed. (70 pages)

FOREIGN SALES OFFICES AND REPRESENTATIVES

ARGENTINA

Rayo Electronica SRL*
Belgrando 990
Pisos 6y2
Phone: 37 98 90
Telex: (390) 012/2153

AUSTRALIA

A. J. Ferguson (Adelaide) Pty. Ltd.
44 Prospect Road
Prospect, S.A. 5082
Phone: 26 91 244
Telex: (790) 82635 (FERGAD)

BELGIUM

(See Germany)

DENMARK

Mer-el A/S
1, Scherfigsvej
DK-2100 Copenhagen 0
Phone: (01) 20 744 44
Telex: (855) 27260 (MEREL)

FINLAND

SW Instruments
Karstulantie 4
SF-00550 Helsinki 55
Phone: 73 82 65/76 24 86
Telex: (857) 12/2411 (SWI)

FRANCE

Tekelec/Airtronic
Rue Carle Vernet
F-92310 Sevres
Phone: (1) 027 75 35
Telex: (842) 250997/204552 (TEKLEC F)

GERMANY (WEST)

R.Ohm Electronics GmbH
D-4051 Korschenbroich
Muehlenstrasse 70
Phone: (02161) 29 805
Telex: (841) 852330 (R.OHM D.)

GREECE

General Electronics Ltd.
209 Thevon Street
Nikaia 77, Piraeus
Phone: 49 13 595
Telex: (863) 212949 (GELT GR)

HONG KONG

R.Ohm Electronics (H.K.) Co., Ltd.
Rm 1027A, Ocean Centre,
5, Canton Road, Tsimshatsui,
Kowloon
Phone: 3-688841/3-672307
Telex: Hx 75294 Hsahk

INDIA

Zenith Electronics
541 Panchratna
Mama Parmanand Marg
Bombay 400004
Phone: 38 42 14
Telex: (953) 011/3152

ISRAEL

CVS Technologies 1974 Ltd.
9 Jabolinsky
P.O.B. 946, Bnei-Brak
Phone: 25 55 06/25 92 41
Telex: (922)

ITALY

I.S.A.B. Spa
Via Achilli Bizzoni 2
I-20125 Milan
Phone: (02) 68 86 306/68 86 315
Telex: (843) 36655 (ISAB)

JAPAN

Panetron Div., Tokyo Electron Labs, Inc.
1, Higashikata - Machi, Midori-Ku
Yokohama 226
Phone: (045) 47 18 811
Telex: (781) 3822865 (PANELEC J)

LIECHTENSTEIN

(See Switzerland)

LUXEMBOURG

(See Belgium)

NETHERLANDS

Tekelec/Airtronic B.V.
Stork Straat 7,
2722 NN Zoetermeer
The Netherlands
Phone: 079-310100
Telex: 33332 (TKLEC NL)

NEW ZEALAND

Professional Electronics Ltd.
126 Kitchener Road
Milford, Auckland 9
Phone: 46 94 50
Telex: (791) 21084 (PROTON)

NORWAY

Hefro Teknisk A/S
Trondheimsveier 80
Oslo 5
Phone: 38 02 86
Telex: (856) 16205 (HEFRON N)

SOUTH AFRICA

South Continental Devices (Pty) Ltd.
Suite 516, 5th Floor, Randover House
Cor. Hendrik Verwoerd, Dover Road
Randburg, Transvaal
Phone: 48 05 15
Telex: (960) 8-3324

SPAIN

Elico Fastronix S.A.
Constancia 43
Madrid 2
Phone: 415 66 54
Telex: (831) 23606 (ELICO)

SWEDEN

Johan Lagercrantz KB
Kanalvägen 5
S-194 01 Upplands Väsby
Phone: (0760) 86 120
Telex: (854) 11275 (LAGER)

SWITZERLAND

Amera Electronics AG
Lerchenhaldenstrasse 73
CH-8046 Zürich
Phone: (01) 57 11 12
Telex: (845) 59837 (AMERA)

TAIWAN

(See Hong Kong)

UNITED KINGDOM

Memec Ltd.
Thame Park Ind. Estate
Thame, Oxon OX9 3 RS
Phone: (084 421) 3146
Telex: (851) 837508 (MEMEC G)

LATIN AMERICA

Intectra
2349 Charleston Road
Mountain View, CA 94043, U.S.A.
Phone: (415) 96 78 818
Telex: 345545 (INTECTRA MNTV)

ALL OTHER COUNTRIES

(Factory Direct)

*Distributor Only

AUTHORIZED STOCKING DISTRIBUTORS

ALABAMA

(Call Exar Direct)

ARIZONA

Choyce Electronic Distr.
2005 W. Peoria Ave.
Phoenix, AZ 85029
(602) 997-6194

ARKANSAS

(See Oklahoma)

CALIFORNIA

Intermark Electronics
4040 Sorrento Valley Blvd.
San Diego, CA 92111
(714) 279-5200
TWX 910-335-1515

Intermark Electronics
1802 E. Carnegie Ave.
Santa Ana, CA 92705
(714) 540-1322
TWX 910-595-1583

Intermark Electronics
1020 Stewart Drive
Sunnyvale, CA 94086
(408) 738-1111
TWX 910-339-9312

JACO
20600 Plummer
Chatsworth, CA 91311
(213) 998-2200
TWX 910-494-1923

NESCO
12053 W. Jefferson Blvd.
Culver City, CA 90230
(213) 391-6294

Western Micro Technology
977 Benecia
Sunnyvale, CA 94086
(408) 737-1660

COLORADO

Century Electronics
Div. of Bell Ind.
8155 W. 48th Avenue
Wheatridge, CO 80033
(303) 424-1985
TWX 910-938-0393

CONNECTICUT

(See Massachusetts)

DELAWARE

(See Pennsylvania)

FLORIDA

Diplomat Southland
2120 Calumet Street
Clearwater, FL 33515
(813) 443-4514

Diplomat Southland
50 Woodlake Drive West
Suite 3, Bldg. A
Palm Bay, FL 32905
(305) 725-4520

GEORGIA

(See Florida)

IDAHO

(See Washington)

ILLINOIS (NORTH)

RM Bodelle Co., Inc.
47 Chestnut Lane
Westmont, IL 60559
(312) 323-9670

ILLINOIS (SOUTH)

(See Missouri)

INDIANA

Graham Electronics
133 S. Pennsylvania St.
Indianapolis, IN 46204
(317) 634-8202
TWX 810-341-3481

Graham Electronics
408 North Street
Lafayette, IN 47902
(317) 742-4006

Graham Electronics
3606 East Maumee Ave.
Fort Wayne, IN 46801
(219) 423-3422

IOWA

Iowa Technical Supply
Suite A
206 Collins Road, NE
Cedar Rapids, IO 52402
(319) 377-5795
TWX 910-525-1307

KANSAS

Radio Supply
131 Laura Street
Wichita, KS 67211
(316) 267-5216

KENTUCKY

(See Indiana)

LOUISIANA

(See Texas)

MAINE

(See New Hampshire)

MARYLAND

Pioneer
9100 Gaither Road
Gaithersburg, MD 20760
(301) 948-0710
TWX 710-828-0545

MASSACHUSETTS

Gerber Electronics
852 Providence Hwy.
Dedham, MA 02026
(617) 329-2400
TWX 710-394-0634

MICHIGAN

Wedemeyer Electronics
2280 S. Industrial Way
Ann Arbor, MI 48104
(313) 665-8611
TWX 810-223-6029

Camelot Electronics, Inc.
37045 Schoolcraft Highway
Livonia, MI 48150
(313) 427-8660

MINNESOTA

Cassidy Electronics
4565 W. 77th No. 125
Minneapolis, MN 55435
(612) 835-7746

MISSISSIPPI

(See Texas)

MISSOURI

Diplomat Electronics
2725 Mercantile Drive
St. Louis, MO 63144
(314) 645-8550

Olive Industrial Elect.
9910 Page Blvd.
St. Louis, MO 63132
(314) 426-4500
TWX 910-763-0720

MONTANA

Flamand Electronic Supply
9 North Broadway
Belgrade, MT 95714
(406) 388-6606

NEVADA

(See California North)

NEW HAMPSHIRE

Yankee Elec. Supply
Grenier Industrial Village
Londonderry, NH 03053
(603) 625-9746

NEW JERSEY

(See New York)

NEW MEXICO

Century Electronics
Div. of Bell Ind.
11728 Linn NE
Albuquerque, NM 87123
(505) 292-2700
TWX 910-989-0625

NEW YORK

Components Plus
40 Oser Avenue
Hauppauge, NY 11787
(516) 231-9200

JACO

145 Oser Avenue
Hauppauge, L.I., NY 11787
(516) 273-5500
TWX 510-227-6232

NORTH CAROLINA

(See Maryland)

NORTH DAKOTA

(See Minnesota)

OHIO

Graham Electronics
239 Northland Blvd.
Cincinnati, OH 45246
(513) 772-1661
TWX 810-461-2896

OKLAHOMA

Components Specialties, Inc.
7920 East 40th Street
Tulsa, OK 74145
(918) 664-2820
TWX 910-845-2215

Radio, Inc.

1000 S. Main Street
Tulsa, OK 74119
(918) 587-9123
TWX 49-2429

OREGON

Radar Electric Co., Inc.
704 S.E. Washington
Portland, OR 97214
(503) 233-3691

PENNSYLVANIA (WEST)

Advacom
1938 Buffalo Road
Erie, PA 16510
(814) 455-8110

PENNSYLVANIA (EAST)

Pioneer
141 Gilbalt Road
Horsham, PA 19044
(215) 674-4000
TWX 510-665-6778

RHODE ISLAND

(See Massachusetts)

SOUTH CAROLINA

(See North Carolina)

SOUTH DAKOTA

(See Minnesota)

TENNESSEE

(See Indiana)

TEXAS

Component Specialties, Inc.
8330 Burnet Rd., Suite 101
Austin, TX 78758
(512) 459-3307

Component Specialties, Inc.
10907 Shady Trail
Dallas, TX 75220
(214) 357-6511
TWX 910-861-4999

Component Specialties, Inc.
Suite 590
8585 Commerce Park Drive
Houston, TX 77036
(713) 771-7237

UTAH

Century Electronics
Div. of Bell Ind.
2258 So. 2700 West
Salt Lake City, UT 84119
(801) 972-6969
TWX 910-925-5686

VERMONT

(See New Hampshire)

VIRGINIA

(See Maryland)

WASHINGTON

Radar Electric Co., Inc.
168 Western Ave. West
Seattle, WA 98119
(206) 282-2511

Sterling Electronics
5808 6th Avenue S.
Seattle, WA 98108
(206) 762-9100

WISCONSIN

Taylor Electric Co.
1000 W. Donges Bay Rd.
Mequon, WI 53092
(414) 241-4321
TWX 910-262-3414

WYOMING

(See Colorado)

CANADA

Future Electronics
5647 Ferrier Street
Montreal, Quebec H4P 2K5
(514) 735-5775
TWX 610-421-3251

R-A-E Industrial Electronics
1629 Main Street
Vancouver, B.C. V6A 2W5
(604) 687-2621
TLX 045-4550
TWX 610-929-3065

PAAR Ind. Electronics Ltd.
4531 Monitoba Road S.E.
Calgary, Alberta, Canada
T2G 4B9
(403) 287-2841

AUTHORIZED HOBBYIST DISTRIBUTOR

Jameco Electronics
A Division of James Electronics
1020 Howard Avenue
San Carlos, CA 94070
(415) 592-8097

AUTHORIZED REPRESENTATIVES

ALABAMA

Rep, Inc.
11547 S. Memorial Pkwy.
Huntsville, AL 35802
(205) 881-9270
TWX 810/726-2102

ALASKA

(Call Exar Direct)

ARIZONA

Summit Sales
7336 E. Shoeman Lane
Suite 116E
Scottsdale, AZ 85251
(602) 994-4587
TWX 910-950-1283

ARKANSAS

(See Texas)

CALIFORNIA (NORTH)

Trident Associates
556 Weddell Dr., Suite 9
Sunnyvale, CA 94086
(408) 734-5900
TWX 910-339-9352

CALIFORNIA (SOUTH)

DeAngelo, Rothman & Co.
12063 W. Jefferson Blvd.
Culver City, CA 90230
(213) 398-6239
TWX 910-343-7429

DeAngelo, Rothman & Co.
8369 Vickers St., Suite N
San Diego, CA 92111
(714) 560-5707

COLORADO

Component Sales, Inc.
5925 E. Evans Ave.
Suite 204B
Denver, CO 80222
(303) 759-1666

CONNECTICUT

Phoenix Sales
389 Main St.
Ridgefield, CT 06877
(203) 438-9644
TWX: 710-467-0662

DELAWARE

(See Maryland)

FLORIDA

EIR, Inc.
450 Seminola Blvd.
Casselberry, FL 32707
(305) 830-9600
TWX 810-535-9213

GEORGIA

Rep, Inc.
1944 Cooleedge Road
Tucker, GA 30084
(404) 938-4358

HAWAII

(Call Exar Direct)

IDAHO

(See Washington)

ILLINOIS (NORTH)

Janus, Incorporated
3166 Des Plaines Ave.
Suite 14
Des Plaines, IL 60018
(312) 298-9330

ILLINOIS (SOUTH)

(See Missouri)

INDIANA

(See Ohio)

IOWA

Dy-tronix, Inc.
23 Twixt Rd. NE
Suite 103
Cedar Rapids, IO 52402
(309) 377-8275

KANSAS

Dy-tronix, Inc.
11190 Natural Bridge
Bridgeton, MO 63044
(304) 731-5799
TWX 910-762-0651

KENTUCKY

(Call Exar Direct)

LOUISIANA

(See Texas)

MAINE

(See Massachusetts)

MARYLAND

Component Sales, Inc.
Suite 14
3701 Old Court Road
Baltimore, MD 21208
(301) 484-3647
TWX 710-862-0852

MASSACHUSETTS

Contact Sales, Inc.
101 Cambridge Street
Burlington, MA 01803
(617) 273-1520
TWX 710-332-6569

MICHIGAN

(See Ohio)

MINNESOTA

(Call Exar Direct)

MISSISSIPPI

(Call Exar Direct)

MISSOURI

Dy-tronix, Inc.
11190 Natural Bridge
Bridgeton, MO 63044
(314) 731-5799
TWX 910-762-0651

Dy-tronix, Inc.

13700 E. 42nd Terrace
Suite 202
Independence, MO 64055
(816) 373-6600

MONTANA

(See Colorado)

NEBRASKA

(See Iowa)

NEVADA

(See California North)

NEW HAMPSHIRE

(See Massachusetts)

NEW MEXICO

Tri-Tronix
2403 San Mateo Blvd. NE
Suite 2, South Bldg.
Albuquerque, NM 87110
(505) 265-8409
TWX 910-989-1680

NEW JERSEY (NORTH)

(See New York City)

NEW JERSEY (SOUTH)

(See Pennsylvania)

NEW YORK (UPSTATE)

Quality Components, Inc.
2095 Kensington Ave.
Buffalo, NY 14226
(716) 839-2044

Quality Components, Inc.

116 E. Fayette St.
Manlius, NY 13104
(315) 682-8885
TWX 710-545-0663

NEW YORK (CITY)

ERA, Incorporated
1 Dupont Street
Plainview, NY 11803
(516) 822-9890
TWX 510-221-1849

NORTH CAROLINA

Component Sales, Inc.
P.O. Box 18821
Raleigh, NC 27609
(919) 782-8433

NORTH DAKOTA

(See Minnesota)

OHIO

McFadden Sales
4645 Executive Drive
Columbus, OH 43220
(614) 459-1280
TWX 810-482-1623

OKLAHOMA

Technical Marketing, Inc.
97171 East 42nd Street
Tulsa, OK 74145
(918) 622-5984

OREGON

(See Washington)

PENNSYLVANIA (WEST)

(See Ohio)

PENNSYLVANIA (EAST)

Dick Knowles Associates
1 Fairway Plaza
Suite 311
Huntington Vly., PA 19006
(215) 947-5641
TWX 510-665-5303

RHODE ISLAND

(See Massachusetts)

SOUTH CAROLINA

(See North Carolina)

SOUTH DAKOTA

(See Minnesota)

TENNESSEE

Rep, Inc.
100 S. Branner Street
Jefferson City, TN 37760
(615) 475-4105
TWX 810/570-4203

TEXAS

Technical Marketing, Inc.
44445 Alpha Rd., Suite 102
Dallas, TX 75240
(214) 387-3601
TWX 910-860-5158

Technical Marketing, Inc.

6430 Hillcroft, Suite 104
Houston, TX 77036
(713) 777-9228

UTAH

(See Colorado)

VERMONT

(See Massachusetts)

VIRGINIA

(See Maryland)

WASHINGTON

SD-R² Products & Sales
14040 NE 8th Street
Bellevue, WA 98007
(206) 747-9424
TWX 910-443-2483

WASHINGTON, D.C.

(See Maryland)

WEST VIRGINIA

(See Pennsylvania East)

WISCONSIN (EAST)

(See Illinois)

WISCONSIN (WEST)

(See Minnesota)

WYOMING

(See Colorado)

CANADA (EAST)

R.F.Q. Limited
P.O. Box 262
Port Credit Postal Station
Mississauga, Ontario
L5G 4L8
(416) 626-1445

R.F.Q. Limited

P.O. Box 213
Dollard Des Ormeaux
Montreal, Quebec
(514) 694-5724
TWX 05-821-762



EXAR